ENGINEERING NEWS-RECORD

MAY 30, 1946

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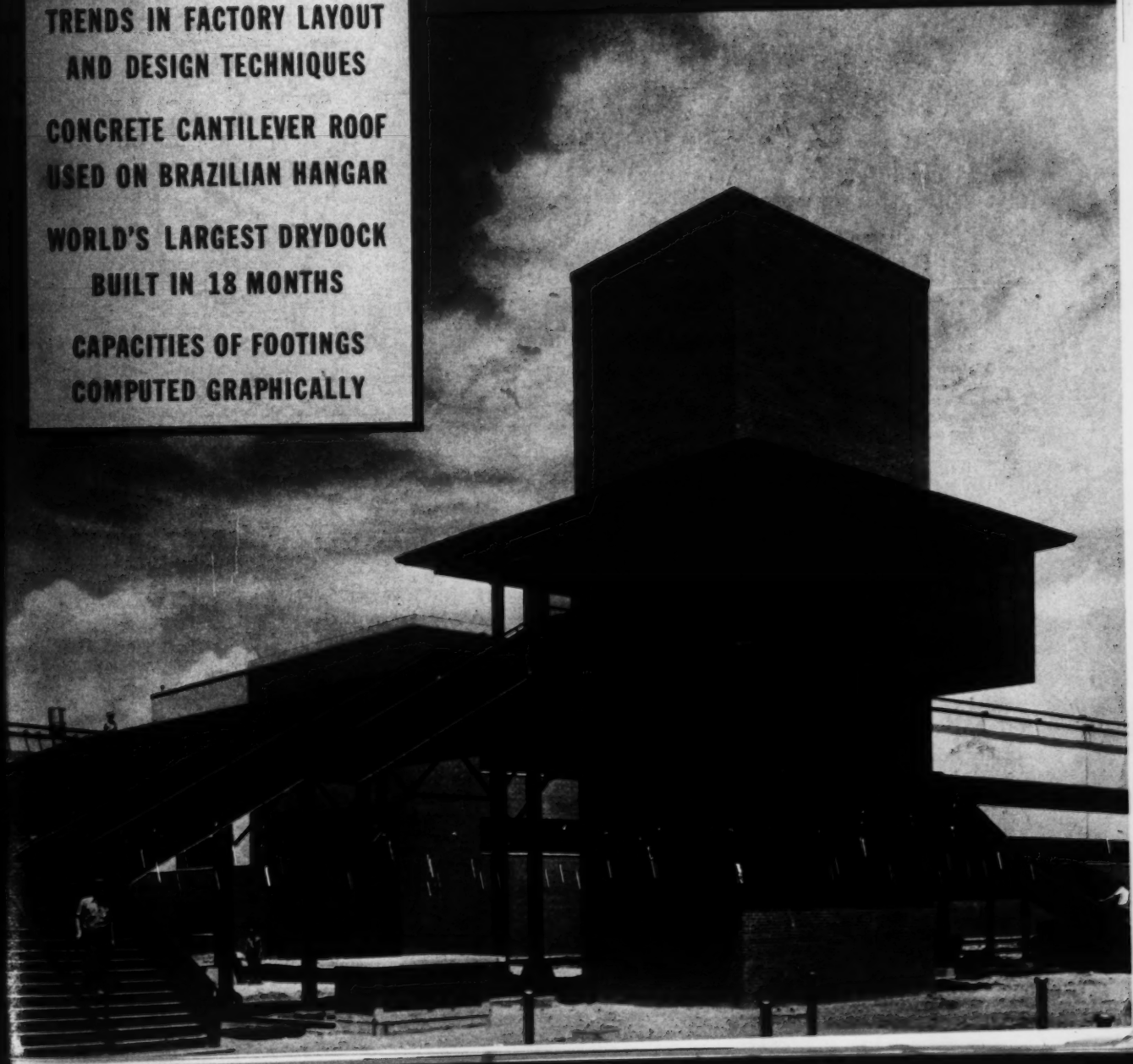
CAPACITIES OF FOOTINGS COMPUTED GRAPHICALLY



1 *Original ARMCO Multi Plate installation—13¼ feet in diameter and 75 feet long.*

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Volume 136 • Number 22 — May 30, 1946

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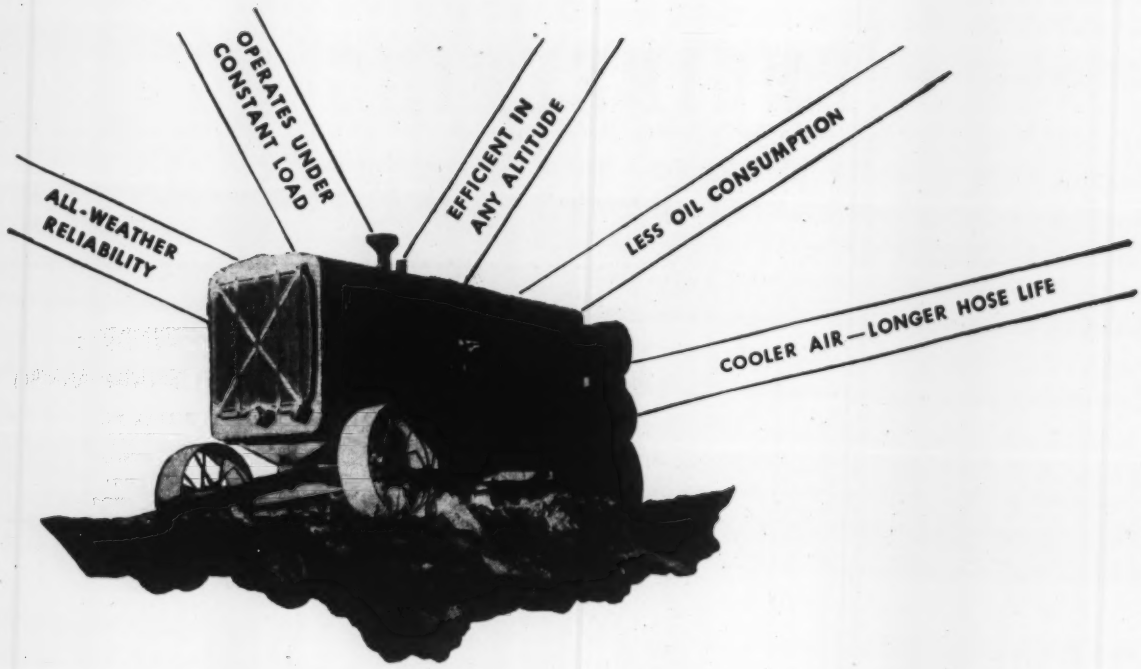

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News of the Week

ENGINEERING NEWS-RECORD • MAY 30, 1946 • VOLUME 136 • NUMBER 22

Lumber shortage may disrupt roads maintenance program

Highway officials canvass states, find inability to obtain timber for needed bridge repairs likely to impede maintenance of states' highway systems

A "serious disruption" in the United States highway transportation system is a distinct possibility because of the critically short supply of lumber which shortage is being aggravated by the demand of a large scale housing program, according to the American Association of State Highway Officials.

In a memorandum to all members of the association, Hal. H. Hale, executive secretary, said last week that the lumber situation appears to be growing progressively worse. The report on which he based his memorandum was compiled from replies sent in by maintenance engineers in each of the 48 states.

"The 48 state highway departments are facing a most serious problem as a result of the current lumber shortage."

"In general, the states have been unable to obtain lumber in any appreciable quantity during the war years, and much deferred maintenance—particularly in timber and combination timber bridges—has accumulated," Mr. Hale said.

"Present conditions give little cause for hope of alleviation of this situation."

"With the already critical lumber situation facing the current home-building program and the great demand for lumber for other uses, the highway departments are apparently going to continue to have difficulty in obtaining badly needed maintenance lumber supplies, the notice continued. The situation is so critical in some areas that the possibility of a serious disruption in the highway transportation system cannot be excluded as a result of the inability to repair and maintain a great number of bridges."

Mr. Hale said that a survey of highway department lumber needs in the field of timber and combination timber bridges indicates that eight of the forty-eight states consider their situation as not yet critical. In 37 states, there are 65,814 timber or combination timber bridges, about 695 miles in length. These figures do not cover bridges not included in the state highway system.

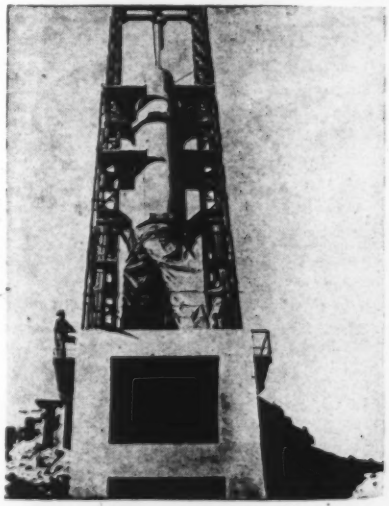
"The indicated shortage of timber needed for urgent repairs to these structures at the present time totals about 24,200,000 b.-ft. This quantity will increase rapidly if the needed maintenance is deferred longer."

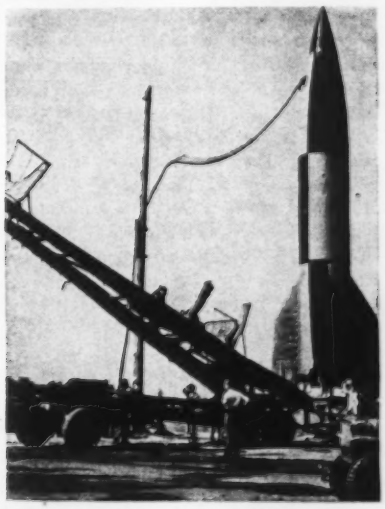
Mr. Hale's report noted that priority ratings in the case of two states have recently been revised. He said that California recently sought priorities for material in the amount of 80,000 b.-ft. to repair a burned out timber bridge on one of its important highways. The request was denied by the CPA, which recently denied a similar request for 987,000 b.-ft. by the State of Texas.

"It is clear, however, that unless some such relief is obtained, the highway departments are confronted with the bare necessity of having to close important roads on which timber bridges have failed or are in danger of failing.

"For example, the state of Oregon—one of the largest lumber producing states in this country—has 1,750 wooden bridges on its highway system. Maintenance of these bridges requires 630,000 b.-ft. of lumber. Up to this time the state has been unable to obtain any appreciable part of its requirements."

Of 45 states canvassed, the AASHO reports listed eight states reporting no lumber needed for maintenance. Other states reported maintenance requirements ranging from 25,000 b.-ft. for Minnesota to 2,500,000 b.-ft. for Alabama and North Carolina.





Rocket Testing—*Rising over the desert terrain of the Army's White Sands, N. M., testing grounds, the steel tower at left and the 45-ft. German V-2 Rocket at right form a strange addition to the desert skyline. The tower, used to test the propellant charge of the rockets, mounts a "motor" for a rocket which is shown between its twin steel columns, capable of lifting 25 tons 60 miles into the air. The reinforced concrete tower base is of open construction to minimize the effect of the 3,000 deg. heat of the charge. At right, a complete rocket is in firing position, after being tilted into place by the special crane shown.*

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Highways—The Oklahoma State Highway Commission asked PRA for a $3,000,000 advance to finance planning. . . . *Kansas* awarded contracts totalling $2,000,000. . . . *Wisconsin* approved plans for spending $2,284,000 for improvements to rural roads. . . . The *Arizona* Highway Commission approved expenditure of $1,230,000 for six road projects. . . . The *Territory of Hawaii* plans to spend more than $1,500,000 on new roads and to repair damage resulting from recent tidal waves. . . . *Emporia, Kan.*, approved a 31-block street resurfacing program. . . . *Virginia* allocated $15,724,000 to be spent on the state's secondary highway system. . . . *Louisiana* voters this summer will be asked to approve a $25,000,000 road-bond issue. . . . *Texas* highway traffic is nearly four percent higher than pre-war peaks, a recent survey indicates. . . . *Pennsylvania* will call bids on the Penn-Lincoln Parkway around *Pittsburgh* on June 13, at Harrisburg. . . . *Missouri* accepted bids totalling $4,103,000 on 23 highway improvement projects.

Sewerage — *Bellingham, Wash.*, retained General Engineering Co., Seattle, to plan a $1,000,000 improvement program. . . . *Anderson, Ind.*, let first contracts for a $500,000 expansion program to extend sewer lines to all suburban areas. . . . *Rockford, Ill.*, engaged engineers to plan line extensions and plant enlargement. . . . Work started on excavations for the $1,250,000 Sims Bayou treatment plant for *Houston, Tex.* . . . *Indianapolis, Ind.*, planned a $750,000 storm and sanitary sewer program. . . . *South City, Calif.*, residents will vote June 11 on an $1,000,000 sewer-bond issue. . . . *Memphis, Tenn.*, planned a $2,664,000 storm sewer project in several of its north-side areas.

Bond Issues—At least $1,400,000 of additional bonds for school construction were approved in *New Mexico*, including a $750,000 series at Albuquerque. . . . *Sedalia, Mo.*, approved an $800,000 issue for school buildings. . . . *Phoenix, Ariz.*, school district voters approved a $1,750,000 issue for a new high school. . . . *La Grande, Ore.*, favored a $329,000 issue for new schools.

Construction—Illinois Bell Telephone Co. will build a new 11-story structure in downtown *Chicago*. . . . Federal Telephone and Radio Corp. will start work at once on a 72,000 sq.ft. aluminum and steel laboratory building at *Nutley, N. J.* . . . The *Montana* Postwar Planning Commission allocated $3,496,000 for construction at state institutions. . . . *Texas* state colleges will cooperate to further building programs totalling more than $21,000,000. . . . More than $2,100,000 worth of construction has been approved by CPA in *Washington* state. . . . *Allegheny County* (*Pittsburgh*) *Pa.*, planned a $9,000,000 home and hospital for the county's indigents.

***Runs Mines**—For the second time in two years, Vice Admiral Ben Moreell, now chief of the Navy's material division, has been called in to operate an industry during strike troubles. Under orders issued May 21, Adm. Moreell became operating chief for the nation's soft coal mines, seized under presidential orders. In October, 1945 while chief of the Bureau of Yards and Docks, Adm. Moreell acted for the government to operate a major portion of the oil industry. In his new duties, Adm. Moreell assists Interior Secretary J. A. Krug.*

Miscellany — The Mississippi River Fuel Corp. has requested authority to spend more than $11,000,000 to triple its natural gas transmission system serving *Louisiana, Arkansas, Missouri and Illinois*. . . . *Pennsylvania's* Registration Board now has more than 1,000 new applications from engineers. . . . *Rochester, N. Y.*, plans $1,282,000 improvements to its municipal airport. . . . Reclamation Bureau engineers began diamond core drilling at the *Monks Hollow* dam site in central Utah. . . . The old city hall of *Pittsburgh, Pa.*, in the center of the downtown business district, has been sold and will be razed to make way for a business building. . . . The U. S. Public Health Service has received a grant for the establishment of 125 fellowships to train physicians and sanitary engineers in public health—information obtainable from the Surgeon General, U. S. Public Health Service, Washington 25, D. C.

Calendar of Meetings

NATIONAL

International City Managers' Association, annual meeting, Montreal, Canada, June 16-21.

Society for the Promotion of Engineering Education, annual convention, Jefferson Hotel, St. Louis, Mo., June 22.

American Society for Testing Materials, 49th annual meeting, Hotel Statler, Buffalo, N. Y., June 24-28.

Society for Experimental Stress Analysis, spring meeting, Hotel Statler, Buffalo, N. Y., June 24-26.

Chinese Institute of Engineers, America Section, annual convention, Hotel New Yorker, New York, N. Y., June 29-July 1.

Associated General Contractors of America. Washington, D. C., spring governing and advisory board meeting, Shirley-Savoy Hotel, Denver, Colo., June 29-July 2.

American Society of Civil Engineers, 1946 summer convention, Davenport Hotel, Spokane, Wash., July 17-20.

REGIONAL

North Carolina Society of Engineers, annual summer convention, Wrightsville Beach, N. C., June 7-8.

Third Hydraulics Conference, State University of Iowa, Iowa City, Iowa, June 10-12.

California Sewage Works Association, 1946 convention, Monterey, Calif., June 9-11.

North Carolina Waterworks Operators' Association, annual operator's training school, Chapel Hill, N. C., June 10-15.

New England Traffic Engineering Conference, third annual meeting, Massachusetts Institute of Technology, Cambridge, Mass., June 11-13.

Ohio Conference on Sewage Treatment, Mayflower Hotel, Akron, Ohio, June 20-21.

Upper Peninsula Road Builders' Association, annual meeting, Houghton, Mich., June 24-25.

New Jersey Section, American Water Forks Association, summer meeting, Little Falls, N. J., June 28.

Ninth Annual Short Course for water and sewage personnel, Louisiana State University, Baton Rouge, La., July 25-27.

Engineer groups approve atomic energy bill

Inclusion of a division of engineering in the commission of civilians that will administer the use of atomic energy under terms of the McMahon Bill, unanimously approved by the Senate Atomic Energy Committee April 11, was lauded by the presidents of four national engineering societies in a telegram to Senator Brien McMahon of Connecticut, the committee's chairman.

Penna. streams drive brings results

Pennsylvania, driving energetically to clear its streams of pollution caused by industry and by the dumping of sewage by municipalities, last week appeared to lead all other states in vigorous administration and in results achieved.

As of May 20, the State Sanitary Water Board had issued a total of 351 orders to industries to prepare plans for treatment of waste waters, and 525 similar orders to municipalities.

Board members, commenting on the results of their campaign, said the results have been "gratifying," and pointed out that industries have complied with the letter and spirit of the board's orders much more quickly than have governmental units. In the coal silt elimination program alone, board members said, 142 anthracite collieries, which produce more than 99 percent of the state's hard coal, have submitted plans for removal of silt from their waste waters. Representatives of the dairy industry have reported the formation of a committee, whose membership includes civil, mechanical and sanitary engineers, to cooperate with the board. Other industries have taken similar action.

Municipalities, slower to respond because of difficulties of financing and control have, however, reported in increasing numbers that they are taking action to comply with the board's orders. In many instances this action is taking the form of sewage disposal "authorities" each involving several communities.

Water board offices

The Pennsylvania State Department of Health, April 13, announced two actions to expand and improve the operations of its Sanitary Water Board. Harry A. Weest, department secretary, said that a district office of the Bureau of Engineering, directed by George A. Morrison, would be opened at Pittsburgh to oversee the mine drainage program directed by the board.

The second move was the establishment of an estimating section of the Bureau of Engineering at Harrisburg, to review plants of sewage treatment work submitted by municipalities in connection with orders of the water board.

Under the direction of Alfons Treo, New Cumberland, Pa., civil engineer, the estimating section will review all plans for the purpose of determining the amount of state aid to be given each municipality.

Other states' action

Meanwhile, other states took action to solve their pollution problems.

In Ohio, officials of cities in the Mahoning River valley met at Youngstown recently to discuss a unified plan for treatment of sewage and industrial wastes, after B. V. DeVier, assistant engineer of the Ohio Department of Health, had pointed out that elimination of pollution in the Mahoning is a "must" in a seven-state pact for cleaning up the Ohio River. Youngstown city officials reported they had already employed consultants to make a survey of that city's treatment needs, prior to launching a $2,000,000 improvement program.

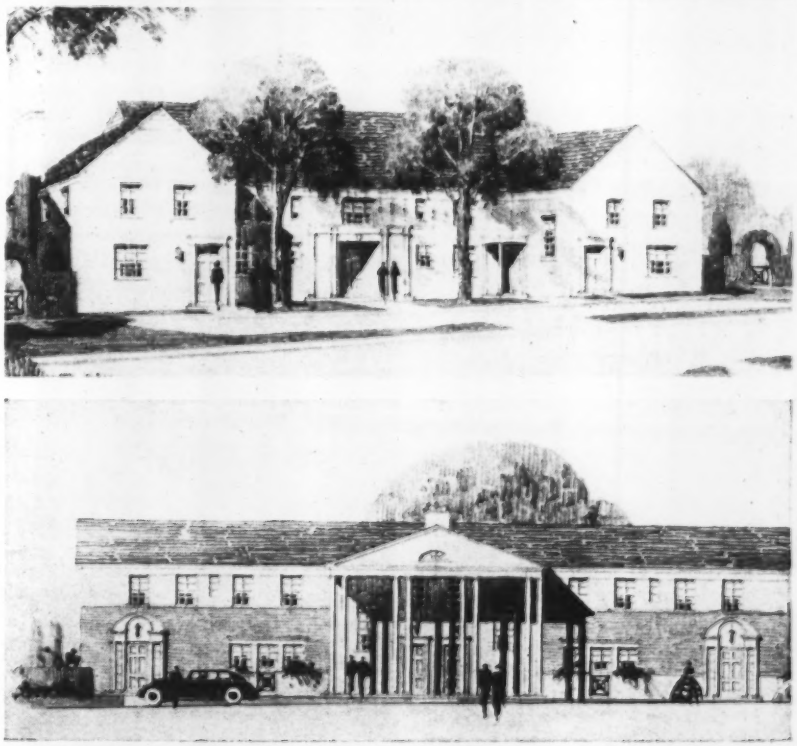
In Indiana, the Stream Pollution Control Board passed a resolution asking that legislation be enacted to aid small communities to finance anti-pollution projects, and announced it would study sections of the Wabash and White Rivers.

Engineering Society gets new research laboratory

Adequate research facilities for serving the entire heating, ventilating and air conditioning industries, as well as associated enterprises, will be provided in property purchased by the American Society of Heating and Ventilating Engineers in Cleveland, Ohio.

The property consists of a large dwelling, with an attached two-story, 58 x 125-ft. concrete laboratory building with brick exterior. In the latter structure, basement space is provided for the heating plant only. There are 5,300 sq. ft. of floor space at grade level, and 4,600 sq. ft. on the second floor, with 18-ft. headroom. To the rear of the laboratory is a large, unshaded area 85 x 300 ft. where equipment for the study of solar radiation will be erected.

Cyril Tasker is director of research, which is administered by a committee of the society.



***Housing for United Nations**—First permanent living quarters for the United Nations staff will be some 120 two-story, garden-type apartment buildings, to be erected immediately on a 40-acre tract near the Flushing, N. Y., site of the 1939-1940 World's Fair. Planned for rental at about $25 per room (for the first three years), the masonry structures will house about 600 families in duplex-type apartments. Landscaping and architectural treatment will make the development a unified community, to be called Parkway Village. UN has agreed with the Savings Bank Trust Co., N. Y., agent for sponsoring banks, to underwrite rentals for three years. Leonard Schultze & Associates, N. Y., designed the project, and the George A. Fuller Co., N. Y. will be the builder.*

President signs housing measure granting subsidies to manufacturers

New law authorizes $100 million for housing expediter's use, grants him broad powers—Other nationwide developments listed

The emergency housing program, intended to provide 2,700,000 homes for veterans in two years through private construction, became law May 22 with its approval by President Truman.

Wilson W. Wyatt, housing expediter, who under the law receives broad controls over building materials prices and exports of scarce lumber, said the legislation threw the program he has urged "into high gear."

The measure provides $400,000,000 for subsidies to spur production of bottleneck materials and increases by $1,000,000,000 the government's authority to insure home loans through private capital, protecting lenders against risks incurred by selling homes on small down payments.

The use of premium payments to expand production of scarce building materials, provided for in the Veterans Emergency Housing Act, will fall within these three general categories:

(1) To defray the extra cost involved in expanding production from currently operating plants beyond the normal optimum limits; (2) to help defray costs of reopening plants closed during the war; (3) to draw in the output of certain high-costs plants which were subsidized during the war but have ceased operation since the war's end.

Other housing work

Other recent developments in the housing field are as follows:

Two-thirds of the first 100,000 temporary emergency dwellings for veterans and servicemen to be allocated to schools and local governments under the Veterans Emergency Housing Program had been completed or were under construction as of May 10, the Federal Public Housing Authority announced.

Of the first 100,000 units of temporary emergency housing which were authorized by Congress in the closing days of 1945, 13,500 had been reported by May 10 as completed. An additional 53,000 were under construction. Construction was about to begin on 30,000 more units.

Plans for construction of 425 new homes in Atlanta, Ga., to cost $2,800,000 have been completed by two building concerns. One of 125 houses to cost $8,000 each, another of 200 houses to cost $6,000 each, and a third of 100 houses in the $6,000 class.

From St. Louis, Mo., comes the report that Herman B. Mayer, developer and builder, has opened a $2,000,000 program for building more than 200 homes on a 40 acres tract in the west end.

The 520 Quonset huts, which Dallas, Tex., obtained under the Mead bill which makes provision for temporary veteran housing, are still for the most part only steel shells with the Federal Public Housing Administration contractor unable to obtain flooring, windows, doors, wall board and, in some instances, plumbing fixtures, to complete them for occupancy.

The University of Houston, Tex., now has 320 trailers ready for occupancy.

Missouri slum clearance

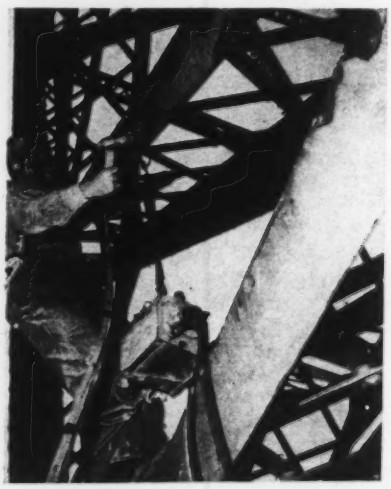
Governor Donnelly of Missouri recently signed a slum clearance bill which provides partial tax relief of 25 years to life insurance companies participating in urban redevelopment corporations, opened the way for direct investment by insurance companies. The bill carried an emergency clause which made it effective on approval by the governor. Three other bills, broadening the scope for investment of life insurance funds to include urban redevelopment corporations, have been signed by the governor.

Plans for a $30,000,000 building program in the Shades Valley section of Birmingham, Ala., providing for the construction of 1,600 homes and multiple apartment buildings to accommodate an additional 400 families, have been announced by the Mountain Brook Development Company of that city.

At Philadelphia, Pa., A. G. Costello will start a 400-home development to cost $3,000,000. Kevy Kaiserman, developer and builder, announces he will build a $1,000,000 apartment project at Broad Street and Stenton Avenue, Philadelphia. Beaston Construction Co. of Philadelphia announces work about to start on 200 homes at Oakmont, Delaware Co., Pa., to cost $2,000,000. At Pottstown, Montgomery Co., Pa., Pottstown Home Builders have announced that work is about to start on two residential developments to cost $900,000.

At Camden, N. J., Baird Boulevard Homes, Inc., announce the start of work on residential developments in Camden to cost $1,000,000.

At Glenside, Pa., bids are being received on a $1,250,000-154-residence development.



Glaspray Process Co. photo

***To Protect Bay Bridge**—Experiments to prevent corrosion of steel members of the San Francisco-Oakland Bay Bridge include the application of a zinc coat, 10/1000-in. thick, applied to 1,300 sq. ft. of the structure exposed to salt spray. A patented "gun" forces powdered zinc into a 1,600 deg. flame, to fuse the metal to the bare steel surface, prepared by grit blasting. Treatment is said to last eight or nine years, as compared with about three years for ordinary paint applications.*

Push construction on Taconic Parkway in N. Y.

Construction of the Taconic State Parkway north from Poughkeepsie toward Albany, N. Y., several miles east of the Hudson River, is going ahead after several years of delay.

From a temporary terminal at its intersection with Route 55, east of Poughkeepsie, northward for 21 miles to Lafayetteville, work on the parkway is now in progress under three contracts, awarded since the end of the war, to complete the grading of this 21-mile extension, as well as construction of six major bridge and grade separation structures, fully preparing the route for final paving and landscaping. Plans provide for two roadways, each with 24-ft. concrete pavement, separated by a center mall.

The State Department of Public Works, acting for and working in close cooperation with the Taconic State Park Commission, prepared the plans and will supervise the construction.

Work under all three major contracts also includes the installation of all necessary drainage structures and facilities, such as culverts, drain pipes, catch basins and ditches. Several small streams will be relocated.

By the end of this year 20.96 miles of the parkway will be prepared for the final paving and landscaping at a total cost of $2,994,265.

Material shortages tie up construction

Contractors, shy of concrete, steel and worried by the other construction materials and general economic situation, are hesitating to bid on highway and other construction projects. The following instances from the East and West are typical of present conditions:

Syracuse, N. Y.—Doubt has arisen as to the prospect of making appreciable headway this year on constructing the "Throughway" across New York state. William Robinson, district engineer of the State Public Works Department reports that no bids have been received from contractors for six sections totaling 24 miles for which engineers' estimates were $6,869,000.

Buffalo, N. Y.—Shortage of building materials will make it impossible this year to accommodate 75% of the persons in its district who want better housing accommodations, according to a survey just completed by the Niagara Frontier Planning Board.

The following findings are embodied in the 60-page report prepared under direction of Marvin A. Rapp, research associate of the board:

1. National production of critical materials is about 50% of estimated housing requirements for 1946.

2. On the Niagara Frontier, building supplies are in general 75% less than required to reach the local housing goal of 7,500 units.

3. The local house-building industry is operating at 15% efficiency because of building deficiencies.

4. OPA regulations must be re-appraised to stimulate the flow of materials, with emphasis on price readjustments, price inequities and production stimulation.

5. Eighty per cent of veterans' demands is unsatisfied in this area.

6. The Niagara Frontier has "plenty of money, land and labor, but houses cannot be built without material."

Oregon—Inability on the part of contractors to obtain basic materials has virtually halted the Oregon state highway commission's construction. Of 11 projects for which bids had been asked, no bids at all were submitted on two major projects and single bids were offered in four instances.

For the same reason the Oregon state board of control's building project may be deferred for a year. Only one bid was received for construction of two buildings at the Fairview Home for Feeble Minded. Only one building in the state program has been contracted for, an addition to the nurses' home at the Eastern Oregon Hospital at Pendleton. The board rejected bids on a proposed dormitory at the Salem State Hospital farm because the low bid ran 60 percent above the prewar estimate.

Favor $600 million rivers, harbors bill

The House Committee on Rivers and Harbors last week reported favorably and without amendment on the Rivers and Harbors Bill (H.R. 6407) authorizing but not appropriating nearly $600,000,000 for river and harbor projects.

The committee, noting that two years have elapsed since passage of the first rivers and harbors measure, and that a number of projects approved at that time were halted because of wartime needs, said that several of these projects had been added to the current bill.

The committee noted that during the year 1944, the traffic on the waterway systems, inclusive of the Great Lakes and ocean transportation, had reached an all-time high of 31 billion ton miles.

Actual first cost authorized by the bill totals $601,725,070. Included in the authorization are $116,941,000 for improvements on the Mississippi River from Baton Rouge, La., to the Gulf of Mexico; $82,300,000 for the Big Sandy, Tug and Leuisa Forks rivers, in Kentucky, West Virginia and Virginia, and $71,000,000 for improvement to the Columbia River and Foster Creek in Washington.

Other major projects authorized include: Appalachicola, Chattahoochie and Flint Rivers in Florida and Georgia, $73,361,000; Arkansas River and its tributaries in Arkansas and Oklahoma, $55,000,000; Red River and its tributaries in Louisiana, $42,000,000; Great Lakes connecting channels, in Michigan; $28,063,000; Illinois waterway and Grand Calumet River, Illinois and Indiana, $21,000,000; Cumberland River and its tributaries in Kentucky and Tennessee, $20,730,000; the culm removal in the Schuylkill River in Pennsylvania, $12,895,000; deep water channel in the Sacramento River, California, $10,742,000; the Texas-Louisiana inter-coastal waterway, $8,000,000; improvements at Cleveland harbor, Cleveland, Ohio, $11,677,000; Mermentau River and tributaries in Louisiana, $7,500,000; and San Diego River and Mission Bay, Calif., $5,858,000.

Construction labor force increases

Labor department notes jump in employment—other developments on labor front reported.

Considerable increases in employment between mid-March and mid-April were reported by manufacturing, construction, and trade establishments to the U. S. Department of Labor. The increase of almost 200,000 workers raised employment in construction to 1,720,000, the highest number since the beginning of 1943. The only employment decline among the major industry divisions was in mining as a result of the coal strike.

The number of production workers in manufacturing increased over the month by 358,000 to a level of 10,982.000. For the most part this increase was concentrated in the durable goods group and reflected primarily the resumption of operations after the settlement of labor-management disputes.

Minnesota carpenters get raise

While employment increased, labor unrest continued throughout the country.

Carpenters, millwrights and pile drivers in seven Minnesota counties returned to work today with a 15-cent an hour wage increase and other contract adjustments.

A wage rate of $1.65 an hour was approved by the wage adjustment board and will affect about 5,000 workers.

The new contract also provides for an eight-hour day, 40-hour week, time and one-half for over-time on weekdays and double time on Saturdays and Sundays.

Utah pay increases rejected

The Utah state finance committee has refused a request for pay increases of 15 percent for state engineering commission employees, it was announced recently.

The prospect that Utah may lose $5,000,000 of federal funds unless project planning is soon completed by the understaffed group was foreseen by Roy W. McLeese, chief engineer, who said the low salaries offered to members of his department were prohibiting applications for the posts.

Following the turndown on pay increases, the finance committee announced its willingness to continue discussions.

Houston engineers against union

The Houston Engineers Club of Houston, Tex., has voted unanimously against unionizing professional engineers. The American Federation of Labor reportedly has been trying to unionize professional engineers, draftsmen and associated workers there.

Cascade bore infeasible Ole Singstad reports

Preliminary studies indicate that a proposed low-level tunnel through the Cascade Mountains between Eastern and Western Washington is not feasible, Governor Mon C. Wallgren announced May 7 after a conference with Ole Singstad, tunnel engineer, who had been retained to survey the project (*ENR* Nov. 22, 1945, vol. p. 693).

Economic difficulties rather than engineering problems present the major barrier to such a tunnel, the governor said, with maintenance costs estimated at "many millions" of dollars yearly.

Mr. Singstad has been working on his survey for six weeks and has not yet completed his studies, the governor declared. His contract also calls for surveys looking to an alternate method of providing an "all-weather" East-West highway, and Gov. Wallgren said early indications on this phase of the program are "encouraging". Most feasible plan shown in preliminary surveys calls for a two to three-mile tunnel at the 2,500-ft. level through Snoqualmie Pass, on the main highway through the mountains.

The 1945 state legislature appropriated $100,000 for the tunnel survey, with a report to be made to the 1947 legislature. The proposed tunnel has been much discussed for many years and it is hoped that Mr. Singstad's report will finally settle the controversial issue.

Santa Barbara rejects high bids on sewer lines

Bids on sewer lines that soared as high as 246 percent above estimates were rejected recently by the Santa Barbara, Calif., city council. City Engineer Chester W. Moore suggested to the council that only one of the projects be readvertised, pointing out that deliveries of pipe in the next six months would barely be sufficient for the one job. The original bid on this line had been the closest to engineering estimates, running about 49.3 percent above that estimate.

Cast iron for lead pipe

The council also legalized substitution for scarce plumbing materials by approving a six months amendment to the plumbing ordinance. Contractors will be allowed to use cast-iron pipe in lieu of lead pipe in connecting soil lines, closet bowls and tub traps; shorten vent pipes from 24 to 12 in. above the roof; substitute brass, copper or government-type K copper tubing for cast iron soil and waste pipe fittings.

Union labor spokesmen opposed the amendment, while contractors maintained it was necessary for the completion of construction now under way.

The San Bernardino County board of supervisors unanimously voted to go along with local industry by substituting concrete for clay pipe in specifications for the city's $250,000 Big Bear housing sanitation project.

Sanitation fee proposed

Cities in Orange County, Calif., may begin charging a $1-per-connection sanitation fee as a result of recent discussions of the county's League of Cities executive council. The proposal is an attempt to finance the enlarging of sewage disposal facilities in the county.

Also under consideration to raise revenues to pay for construction is a possible boost in city sales taxes from the present 2½ percent to 3 percent. It was pointed out at the meeting that this could be collected through the state tax-collection machinery, thus simplifying procedure for raising and collecting funds.

Foreign engineer group studies U. S. road building

International cooperation of a practical nature will be demonstrated by a 2,000-mile study tour of the middle western states by highway engineers of 19 countries who left Washington early this week, the first objective being the Pennsylvania Turnpike.

The engineers have just completed a five week's Inter-American highway course in the National Academy of Science building at Washington. The school and study tour are sponsored by the American Road Builders' Association, with the cooperation of the State Department, Office of Inter-American Affairs, Public Roads Administration, and Pan American Highway Confederation.

Representative highway officials from 16 Latin American republics, were those for whom the course was originally planned. The sessions were just beginning when 11 engineers from China, two from Egypt and one from India, in the United States on official study tours, asked and were granted permission to participate.

A variety of subjects covering all phases of road building science was included in the lectures which were completed May 17. Experts from state highway departments, federal government agencies, municipalities, equipment and materials manufacturers and construction firms have been lecturing each weekday since April 8.

St. John's River deepening plans are under way

The Chamber of Commerce of Jacksonville, Fla., is laying the groundwork for the proposed deepening of the St. Johns River channel, to increase the city's value as a port.

Dredging of the channel to a depth of 34 ft. from the city to the jetties is a $6,000,000 job that will take the U. S. Engineers three to five years to complete. The initial project is the widening and deepening of the terminal channel from Commodore's Point to Long Branch, which will cost approximately $1,700,000 and will require the removal of 3,000,000 cu.yd. of rock and mud.

Jacksonville also will furnish to the federal government without charge the necessary spoil disposal areas, as the chamber's commerce waterway improvement committee has a program to obtain the needed land.

Before the war the present channel depth of 30 ft. was inadequate for shipping. Large tankers and vessels, before entering the port were forced to leave behind part of their cargoes. With new deep-draft tankers being used now, the problem is worse than ever. It is estimated that when the dredging project is finished, petroleum shipments to Jacksonville will increase 50 per cent.

Big irrigation project at San Joaquin forecast

Construction of a $5,585,000 underground pipe system for irrigation in the southern San Joaquin, Calif., Municipal Utility District and an adjacent area was forecast last week when preliminary plans were reviewed by district engineers and directors. Designed by Bureau of Reclamation engineer Lee Hostetter, the project would be financed under a low-interest long-time loan from the federal government.

The district, first to sign for long-term water delivery with Central Valley Project authorities, (*ENR* Nov. 22, 1945, vol. p. 693) will be furnished Friant-Kern Canal water for a maximum of 39 years, according to terms of the contract.

Three main intakes were planned to draw water from the canal at points near the Tulare-Kern County line. At one intake, a pumping plant would lift the water to a 575-ft. level for irrigation of the 17,000-acre Jasmine area and San Joaquin district acreage lying above canal elevation.

A preliminary estimate of costs placed construction of the system at about $87.50 per acre served.

Reconstruction of highway network in Philippines to cost $100,000,000

PRA survey reveals need for extensive bridge construction and resurfacing work—Army Engineers to report soon on harbor needs.

Reconstruction of the highways in the Philippines will cost in the neighborhood of $100,000,000, American engineers sent to the islands to study that country's needs reported last week.

Although their estimates are preliminary, Maj. Gen. Philip B. Fleming, Administrator of the Federal Works Agency, and Commissioner Thos. H. MacDonald of the Public Roads Administration report that about $100,000,000 will be required to reconstruct the highways of the Philippines. The two men made their report recently after a round-the-world trip that called for surveys of the road networks of both the islands and India.

Much bridge work needed

Practically all the main roads of the islands were severely damaged by destruction of most bridges. The work to date to place these routes back in service has called primarily for temporary construction at the bridge sites. Therefore, much bridge building will be needed. Moreover, maintenance during the war was very limited and to get the roads back into condition much construction other than bridge work will be needed.

Fortunately, there is a tremendous amount of roadbuilding machinery in the Philippines. However, road-building materials are limited, new quarries need to be developed and the two available cement plants have such limited capacity that it will be necessary to import large quantities from the West Coast of the United States.

The PRA, which recently had a group of seven men in the Philippines studying road construction needs, plans to establish a division office in the islands. Most of the work to be done by the PRA will be by contract. The highway reconstruction program is expected to require five years. It is anticipated that any aid the U. S. gives the Philippines for highway work would be matched on a 50-50 basis.

Army Engineers study port needs

The President, on Aug. 20, 1945, requested the Secretary of War to have the Corps of Engineers study requirements for the rehabilitation and expansion of port and harbor facilities in the Philippines and to prepare a report with general plans and estimates of the cost of such additional works as may be needed in the postwar period, both from the standpoint of national defense and reasonably prospective commercial development. He asked that this report be coordinated with the report of seven PRA men previously mentioned (*ENR* Oct. 25, 1945, vol. p. 546).

Col. Charles L. Hall, then division engineer of the Ohio River Division, acted as head of the Army team, which included Lt. Col. Harry Pockras, Benjamin R. Wood and Clarence F. Wicker.

It is understood that the findings of the study by the Army Engineers will be made public in the near future. Considerable harbor and port construction was done by the American invasion forces, but this was only sufficient to handle war needs. To rebuild the port sufficiently to handle peacetime traffic, considerable construction remains to be done.

Rehabilitation act passed

President Truman has signed two acts (H.R. 5856 and S. 1610) providing the Philippines with assistance on reconstruction work. This legislation authorizes an appropriation of $120,000,000 for construction work in the islands. Four general types of work are planned: (1) highway facilities, (2) port and harbor work, (3) reconstruction of public buildings, most of which were severely damaged, and (4) the establishment of health centers.

The rehabilitation act authorizes the U. S. Army Engineers to train not to exceed 10 Filipino engineers from among the regular engineers of the Philippine Army and the staff of the Philippine Public Works Department. These men will be trained in construction, maintenance of port facilities, and rivers and harbors work.

Plan Dayton, O., bridge

Plans are being prepared for a bridge to be known as the First-Salem Bridge over the Miami River at Dayton, Ohio. Erection of this structure, to measure 650 ft. between abutments, was approved by voters at last November's election as part of a 10-year capital improvement campaign sponsored by the Dayton District Development Committee. It will provide an artery from the populous Dayton View area to the city center.

Plans call for five arch spans of reinforced concrete, carrying a 6-lane roadway with a center strip, and two 8 ft. sidewalks.

Cost is estimated at $764,000. An additional cost of $240,000 will be for constructing separation grades. Another $200,000 will be spent for real estate.

Philippine engineer head here to study U. S. plans

Col. Amado N. Bautista, Chief of Engineers of the Philippine Army, is now making an intensive study of U. S. Army Engineers' methods with a view to putting similar ones in effect in his own country. Colonel Bautista is at the office of Lt. Gen. Raymond A. Wheeler, Chief of Engineers, and his study will include visits to civil works projects in the field, and Fort Belvoir, Va.

Colonel Bautista commanded the 11th Combat Engineer battalion, which was in continuous action against the Japanese from Dec. 10, 1941, to April 10, 1942. In 1936-37 he was military district engineer, Northern Luzon. From 1937 to 1940 he was executive officer, Headquarters, Philippine Army, and chief of construction and operations. From May to August, 1945, he attended the Command and General Staff School at Fort Leavenworth, Kan. He was made Chief of Engineers of the Philippine Army in February of this year.

Seek ruling on taxing Ohio municipal utilities

A taxpayer's suit in the District Court of Appeals at Columbus, Ohio, has asked issuance of a writ of mandamus commanding the State of Ohio to assess and levy taxes on the real and personal property of every public utility except water works owned and operated by municipalities or other governmental subdivisions.

The taxpayer's suit was filed March 19 by William A. Williams, of Rocky River, who charged that he had demanded that the tax commissioner make an assessment against publicly-owned utilities, but that the commission had refused to do so.

The action stems from the Ohio State Supreme Court's decision June 6, 1945, holding that the city-owned Cleveland Transit System was subject to real and property taxes. State Tax Commissioner Emory Glander recently ruled that all city-owned utilities except transit systems were exempt from such real and property taxes.

ENGINEERING SCHOOL NEWS

Canadian engineers create educational fund—New building planned at Duke—Case raises tuition—Surplus LST's for housing at R. P. I.

The Engineering Institute of Canada is establishing the Harry F. Bennett Educational Fund to set up engineering and science scholarships and fellowships and to award them to deserving persons, to encourage the establishment and maintenance of engineering and science departments in schools and colleges, and to make loans to deserving students to enable them to pursue engineering and scientific studies. A campaign is under way to raise a minimum of $25,000 to start this fund.

Mr. Bennett for six years prior to his recent death was chairman of the institute's committee on the training and welfare of the young engineer. The general campaign committee consists of J. A. Vance, chairman, E. V. Buchanan and R. E. Heartz.

A new vice-presidency of Cornell University has been created by the Board of Trustees to be filled by Dean S. C. Hollister of the college of engineering. Dean Hollister will continue as head of that college while assuming new administrative duties. As a vice-president of Cornell, he will be in charge of university development.

Dean of the engineering college since 1937, Mr. Hollister was first appointed to the Cornell staff in 1934 as director of the school of civil engineering. Prior to that he was professor of structural engineering at Purdue University. He has served as consultant on the Boulder Dam project. He also served the U. S. Engineer Department as consultant on testing methods and devices in soil mechanics, and the U. S. Maritime Commission as consultant on concrete ship design and construction. Among his achievements at Cornell has been a comprehensive building program for the development of the physical plant of the college of engineering.

The University of Washington Board of Regents at Seattle will open bids soon for completion of its civil engineering building at an estimated cost of $500,000. Work on the first unit of the building, a material testing unit, is now nearing completion. Its estimated cost is $200,000, bringing the total cost to $700,000. The structure will be 208 by 70 feet and four stories high, of brick exterior with cast stone trim.

The board of trustees of Case School of Applied Science has announced that, beginning Sept. 1, tuition will be raised to $500, including fees, for a normal year, representing an approximate increase of $100 over present rates. Proportionate raises in rates for evening and graduate students also are to be put into effect.

Rensselaer Polytechnic Institute, Troy, N. Y., which has a normal student body of 1,450, plans to increase its capacity to 3,122 by the opening of the fall term. One project calls for the mooring of four surplus LST's in the Hudson River off Troy to provide dormitory facilities for 600 veteran students.

Ten days after the start of the spring semester at the University of Texas an enrollment of undergraduate engineering students of 2,433 was indicated. When graduate students are included the total is around 2,500. The civil engineering department expects a further increase next fall, perhaps as much as 20 percent. Registration of out of state students is being restricted. It is limited to college transfers having a B average or high school graduates in the upper quarters of their class.

Plans for the construction of a new building to house the Duke University school of engineering, and to cost several million dollars, have been announced. The new building is expected to be twice the size of the four buildings now used by the school, and according to Dean William H. Hall will make the facilities of the engineering school comparable to those of the other leading engineering plants and institutions. The building will be designed to care for a maximum of 400 undergraduate students, will be three stories high, with a front section 250 ft. long and 50 ft. deep, and with three wings, measuring 45 by 100 ft.

The civil engineering division will contain laboratories for sanitation, soil, cement, concrete, highway materials, strength of materials.

California teaching post goes to Colonel Gotaas

Col. Harold B. Gotaas, president of the Institute of Inter-American Affairs, has been appointed professor of municipal and sanitary engineering at the University of California, according to reliable reports. This post has been vacant since the retirement of Prof. Charles Gilman Hyde several years ago.

Colonel Gotaas is now on terminal leave from the Army Sanitary Corps, in which he was commissioned as a captain in 1942. Since that time he has been assigned to the Office of Inter-American Affairs, where he served successively as chief engineer of the health and sanitation division, and director. The division is engaged in the promotion of cooperative sanitation programs in 18 Latin-American Countries.

In September, 1945, Colonel Gotaas was elected president of the Institute of Inter-American Affairs, the corporate agency that directs and administers funds for Latin American sanitation, transportation and food programs. He will continue to occupy this post in a civilian capacity until late this summer.

To Inspire Engineering Students—To keep freshman engineering students constantly inspired with the potential fruits of engineering fields in which drawing is basic, this 4x8-ft. photographic mural has been placed on the wall of the Cooper Union, New York City, engineering drawing classroom.

OBITUARY

Alfred Walter Booth, 59, government civil engineer for 33 years, died in Washington, D. C., May 20. He was a graduate of Princeton University, 1911, and went to Washington two years later to join the Interstate Commerce Commission as a civil engineer.

Charles M. Phillips, 75, city engineering and safety director at Mt. Vernon, Ohio, for 30 years, died May 15.

Lee Treadwell, 81, a retired civil engineer who had long specialized in the design of movable bridges, died in Atlanta, Ga., May 15. A native of Texas, Mr. Treadwell lived in Pine Bluff, Ark., and Kansas City, Mo., before moving to Atlanta 13 years ago. For several years he acted as a consultant bridge engineer in Canada and the United States. A graduate of the University of Arkansas, Mr. Treadwell had been chief engineer of the Union Bridge & Construction Co. of Kansas City, Mo., chief engineer for the Navy drydock at Portsmouth, N. H., and of the Lake Pontchartrain bridge at New Orleans.

George Almon Craig, 89, died May 11 in Los Angeles, Calif. He was in railroad construction work for many years in the Cleveland, Ohio, area, and at one time was in charge of construction of the Washington, Baltimore & Annapolis Railroad. He built foundations and abutments for the Wheeling & Lake Erie Railroad.

John F. Dietz, 61, superintendent of public works of Mundelein, Ill., northwest of Chicago, for 30 years, died May 14 in Waukegan, Ill.

Madison M. Cannon, 73, civil engineer in charge of construction of the Arlington Memorial Bridge across the Charles River in Massachusetts died May 18 in Auburndale, Mass. Mr. Cannon was graduated from Massachusetts Institute of Technology 1895, and was formerly engineer on the Ware, Mass., waterworks dam, and later was connected with B. Perini & Sons Co., contractors.

H. S. Kollenborn, 59, civil engineer with the U. S. Bureau of Reclamation, died in Los Angeles, Calif., May 10.

William Van Bokkelen, 60, consulting engineer of Berkeley, Calif., died May 20.

Royal H. Sillitoe, 55, former Trumbull County, Ohio, engineer, died May 19 in Warren.

Stone&Webster designers end nine-week strike

A nine-week strike of tracers, draftsmen, designers and squad chiefs in the design division of the Stone and Webster Engineering Corp. at Boston, Mass., ended May 27 with the signing of a one-year contract between the corporation and Local 105, International Federation of Technical Engineers, Architects and Draftsmens unions, AFL.

The engineering division of Stone and Webster was not involved in the strike.

The agreement provides for a 20 percent increase in wages and for certain changes in overtime pay, retractive to Feb. 25, 1946. According to representatives of Stone and Webester, both the above adjustments had been offered to the union as of Nov. 26, 1945, and would have been effective for the past six months if accepted at that time. (*ENR* April 14, vol. p. 461)

The new rates range from 72 cents per hour minimum for tracers to $2.12 per hour minimum for squad chiefs. These increases, according to the company, will result in average wage increases of not over three cents per hour as compared with the company's offer prior to the strike. The company states that certain working practices which have been enjoyed by the division employees for many years — including 11 holidays per year with pay, severance pay and sick leave privileges are continued in the new contract.

Aside fro mthe loss of three months' retroactive pay increases, the corporation estimates that as a result of time lost during the strike period, it will require on the average over nine years at the new rates for the striking employees to offset their loss in pay through rejecting the company's offer before the walkout.

Maurice J. Scott, president of the union, said that averaging the increases gives a misleading picture of the gains made by the men, because the 20 percent increase in minimum rates will give over half the men increases ranging from 35 to 60 percent.

About 600 men went out originally, but a few stayed on the job. These were augmented from week to week until about 100 were working at the time of the settlement. Under the settlement agreement, the company will take back the employees who went on strike as quickly as possible.

Louisville, Ky. — Federal, statae and city engineers were instructed on May 14 to draft immediately an over-all plan for a $30,000,000 express highway program for Louisville, Ky., to relieve traffic congestion on routes entering and leaving the downtown area.

CONSTRUCTION ACTIVITY

As Reported this week to ...
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only (Thousands of Dollars)

	Week of May 30 1946	Cumulative 1946 (22 wks.)	Cumulative 1945 (22 wks.)
Federal	$5,415	$248,770	$398,989
State & Mun.	37,028	498,397	95,411
Total Public	$42,443	$747,167	$494,400
Total Private	29,412	1,329,550	191,141
U. S. Total	$71,855	$2,076,717	$685,541

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1946 (22 wks.)	Cumulative 1945 (22 wks.)
Waterworks	$443	$41,306	$17,001
Sewerage	881	26,818	11,985
Bridges	4,118	50,433	11,097
Highways	26,465	287,048	67,251
Earthwork, Waterways	2,836	150,694	14,427
Buildings, Public	6,283	123,703	276,657
Industrial	13,989	417,434	132,325
Commercial	12,363	831,202	34,922
Unclassified	4,477	148,079	119,876

NOTE: Minimum size projects included are: Waterworks and waterway projects, $22,500; other public works, $40,000; industrial buildings, $55,000; other buildings, $205,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1946 (22 wks.)	Cumulative 1945 (22 wks.)
NON-FEDERAL	$436,159	$260,700
Corporate Securities	187,317	74,812
State and Municipal	248,842	164,988
RFC Loans	.....	20,900
FEDERAL	158,320	251,010
Total Capital	$594,479	$511,710

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	May '46	339.69	163.29
Building Cost	May '46	257.25	139.06
Volume	Apr. '46	340	149

EDITORIALS

VOLUME 136 NUMBER 22

May 30, 1946

Current Trends in Construction

LAST WEEK this journal published the result of its study of construction trends since the Civilian Production Administration issued its order of March 26 restricting all building work other than housing for veterans. The survey showed that private construction has leveled off since the order was issued. The weekly average, however, still is considerably above 1945, thus indicating that the most that can be charged against the CPA order is that it may have checked an upward trend in building work. And there is good reason for concluding that a considerable part of such checking as has occurred was due to causes other than the CPA order of March 26. A more probable cause for any slowing down that occurred is the continuing shortage of building materials (*ENR* May 9, vol. p. 747). In view of the common sense manner in which most of the regional committees set up to review applications for exceptions from the CPA order are approaching their task, it seems probable that the trend of construction for the remainder of the year will depend more on the available supply of materials and labor than on curtailments of work resulting from the CPA order. On May 22 the President signed the bill authorizing subsidies to stimulate production of scarce building materials, but that legislation can have little effect for some months.

Early Disposal Desired

QUANTITIES of construction machinery and building materials are being returned from the Pacific war theater by the Army and Navy, as reported in these pages May 2, (vol. p. 687). In view of the extreme shortage of these items here at home, this work is worth while, and the Army and Navy are to be complimented on their efforts. However, much of the benefit of returning the supplies will be lost if the War Assets Administration cannot get its selling organization geared for quicker disposal than has been possible with many items in the past. Veterans have first chance to purchase construction machinery, but the disposal procedure should be changed to permit quick sale to others if the veterans do not desire to buy. Otherwise benefits to the veterans' housing program and other construction will be materially reduced and the veterans' difficulties in finding homes and jobs extended. Moreover, the longer the delay in disposing of war surpluses, the greater will be the danger of competition with our postwar economy. This, too, has an important bearing on jobs for veterans. Rapid disposal of returned construction surpluses will benefit everyone.

Register for College Early

IN VIEW of the assuredly inadequate facilities of most of our engineering colleges to handle an unprecedented number of registrants, too much emphasis cannot be placed on the need for early registration of engineers planning to attend college. Many of the universities and engineering colleges throughout the country have launched enlargement programs to accommodate the heavy registrations expected this fall, yet even the most optimistic estimate of the total facilities available in September indicates that many a would-be student will fail to gain admittance at that time. This condition needs to be recognized by the many engineers who are serving on student guidance committees around the country or who are approached by high-school boys for advice about studying engineering.

Factories Underground

REALIZATION of what atomic warfare would do to our presently accepted mode of life is brought vividly home by announcement that the Army and Navy are surveying natural caves throughout the country as to the possibility of converting them into underground munitions factories in case of need. It is not a pleasant prospect but one that must be faced by military authorities, charged as they are with the responsibility for our defense. Inevitably, civil engineers and construction men must also consider the question of underground factories, for it is they who will have to design and build them.

In this connection it is interesting to recall some figures collected by the U. S. Strategic Bombing Survey as to the magnitude and cost of underground factories in Germany. Underground construction was initiated there on a large scale in 1944, and by the end of the war such work represented 40 percent of all industrial construction. Plans were laid to build almost 100,000,000 sq. ft. of underground factories, and about one-sixth of this total was completed by the end of the war. These factories were for the

manufacture of motors, airframes and electrical equipment, and an additional program was underway to house the synthetic oil industry underground. The estimated unit cost of this construction was between $5 and $10 per sq. ft., which if applied to the many acres of industrial floor space created in this country for war production results in a staggering total.

Beyond mere size, however, underground factory construction would raise new technical problems of excavation, drainage, ventilation, lighting and roof support. Camouflaged access roads would be required, and in general a wholly new approach to industrial construction practice would have to be developed.

The best way to avoid such costly and difficult construction is to make warfare impossible. But in the meantime it is not inappropriate to consider ways and means of implementing a program of underground factory construction should it ever be necessary to protect ourselves in a war of atom bombs and rockets.

More Water Power Development

WATER POWER SITES that appeared unattractive two or more decades ago now offer opportunities for economical development, according to L. F. Harza, Chicago consultant on hydroelectric power (*ENR* May 23, vol. p. 823). This change has come about as the result of a combination of circumstance—a sharp decline in interest rates, expansion of federal control over water power, and new public policies with respect to river development.

Fixed charges are a major factor in determining economic justification for water power development, hence the current decline in interest rates to half or more of what once were common rates on power company securities has made possible a much larger initial investment per horsepower of installed capacity. This gain is applicable to either public or private development, with a slight margin in favor of public development.

Federal control over power was broadly expanded when the Supreme Court held that any stream supplying water to a navigable river is subject to federal control. This greatly increased the number of streams on which part of the cost of a storage dam and reservoir could be allocated to navigation. Similarly, extension of federal interest in flood control to the headwaters of most rivers made it possible to reduce further the investment chargeable to power on a multiple-purpose project. These extensions of federal interest have materially reduced the number of sites that are attractive to private capital.

The economic soundness of the federal policy that permits allocation of part of the cost of multiple-purpose projects to navigation and flood control has been under attack for some time, recently being carried to the extreme of holding that there is no economic justification for any multiple-purpose reservoir. While it is true that the economic justification for some of the multiple-purpose projects that have been built or are proposed is tenuous, the fact remains that many such projects are wholly sound under a reasonable application of the new federal policies. Further, now that the practice of allocating part of the cost of such projects to navigation and flood control has been accepted by Congress as national policy, local communities would be foolish not to take advantage of that policy in order to get power at low cost.

Finally, a public agency, in developing a power site, can afford to take the risk of making a much larger initial power installation than could a private company, which cannot afford to tie up capital beyond that required for visible markets. Mr. Harza cites the federal power-building program of the early Thirties as an example, a program designed primarily to create jobs, but also one in which it was hoped to attract industries to undeveloped regions by making power available at low rates. Many people, including the editors of this journal, looked upon that program with a large amount of misgiving. It seemed much too visionary. Looking back at it today, there are few who would not now admit that the optimism of the proponents of the TVA and other power projects was justified. Those plants made a major contribution to the war effort and are not idle today.

With a few notable exceptions, most of the more attractive water power sites have been developed. Many of those that remain should be reappraised in the light of the changed conditions cited by Mr. Harza. Decisions for or against a particular project need to be tempered by what we have learned in the past decade.

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The Wright Aeronautical Corp. plant at Lockland, Ohio, is located on a good highway away from congested city areas.

Trends in Factory Layout and Design

***Contents in Brief**—Designs of contemporary industrial buildings illustrate features affecting plant operation and employer-employee relationships to which designers might profitably devote much thought in planning future factories. These considerations were outlined in a talk recently made before the Rochester Society of Architects and the superintendent and production managers group of the Industrial Management Council by George H. Miehls, president of Albert Kahn Associated Architects and Engineers, Inc. The following is an abstract of this speech.*

TRENDS in industrial building design, not always clearly defined before the war, stand out in sharper relief today, in the opinion of George H. Miehls, president of Albert Kahn Associated Architects and Engineers, Inc. He visualizes the future factory located with a view to good transportation, but outside congested urban areas, providing flexible layouts, and planned to improve employer-employee relationships through provision of convenient facilities for the worker.

Pointing out that location of industrial plants away from cities permits convenient distribution of facilities and provision for expansion, Mr. Miehls says that while availability of manpower in the immediate vicinity is desirable, it is not of primary importance.

Flexible layouts emphasized

A phase of design to which considerable thought should be given is internal arrangement of the plant. Since changing production requirements to achieve increased economy call for constant alteration of layout, flexibility in plan is needed to achieve that efficiency without major structural alterations. This flexibility will be obtained in new plants by various means, and the means will differ with the type of product to be manufactured. It will be facilitated by anticipating the principal service requirements and satisfying them so as to permit service connections at any point with minimum cost and least disturbance to manufacturing operations.

In general, Mr. Miehls believes, for the large majority of mass-produced items, the one-story production layout using horizontal conveyance of materials from receiving through shipping has proved to be more successful than the multi-story layout using so-called gravity flow.

Departments in the new industrial plant will be arranged to effect a simple, direct flow of production in order to eliminate costly handling of materials. The ideal solution for economical production will usually be found in routing raw materials or parts for assembly to one section of the plant, and then in uniform flow through the plant, not necessarily in a straight line, but without the necessity of crossing and recrossing production lines, to points of assembly, storage and shipping.

A question that constantly comes up is: Should the industrial building be of monitor type to provide the maximum of daylight throughout, or should it

Controlled lighting and ventilation facilitate high standards of workmanship in the interior of Wright Aeronautical Corp. factory. The large floor area without obstructions from the structural frame of the building is worthy of note.

be of the flat-roof type with controlled ventilation and controlled lighting?

"As a result of our investigation," Mr. Miehls states, "and except for buildings which are used for forging operations, or foundries, where monitors are practically mandatory, we have found that the initial capital costs of buildings without monitors are less than those with monitors; that operating costs of mechanical ventilation are higher for buildings without monitors than for those with monitors; that heating costs are higher for buildings with monitors than for those without monitors; that lighting costs for the initial installation are the same for both types. Therefore, in general, except for the psychological advantage that the monitor-type building may provide, the trend is toward the artificially lighted, artificially ventilated plant, with sash in the side walls, where the worker can see what the weather is out-of-doors and which minimizes the atmosphere of confinement."

Employee facilities

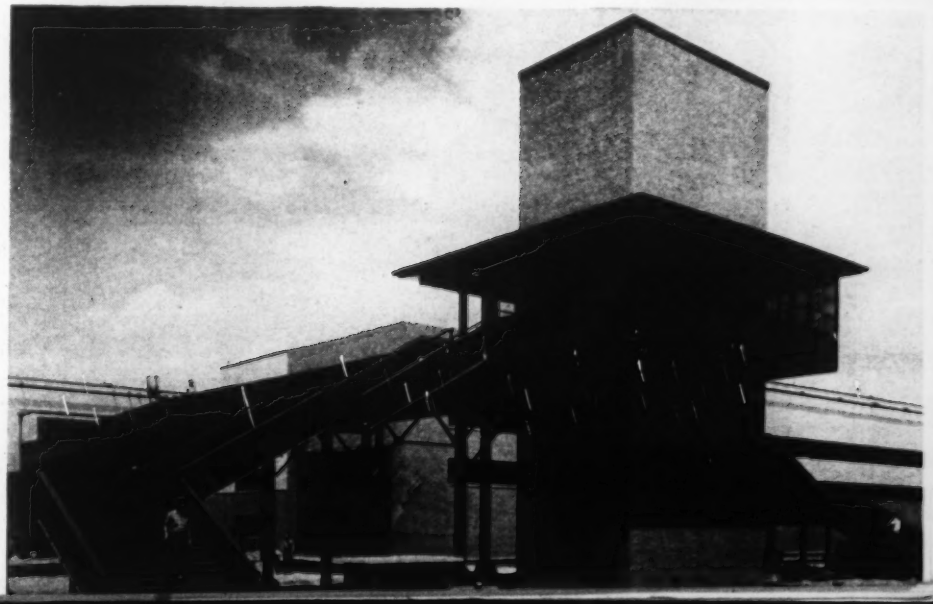
Greater emphasis will continue to be placed on relations between capital and labor. It is essential therefore that management provide agreeable and convenient employee facilities.

The future industrial plant will provide adequate area for the parking of employee's cars. Parking lots will be hard-surfaced, well-drained and located as near employee entrances as possible, usually divided into two sections to save travel time both to and from the plant.

Ample entrances leading from the parking lots or public transportation terminals to the employees' locker rooms are essential. It is equally necessary that the flow to and from these entrances be uninterrupted by obstructions and dangers of crossing railroad tracks, truck highways, or production lines. Locker rooms, toilets and other employee facilities should, therefore, not be located on the production floor. Mezzanines, easily reached by means of elevated walkways, may be provided for these facilities if headroom requirements permit.

More advantageous, however, is the layout that provides for the entrance of employees through underground passages giving access to conveniently assigned basement locker rooms and to places where the men work. Entrances through tunnels require the least height of a climb to reach the operating floor, and proper distribution of entrances permits almost instantaneous changing of shifts. This type of access eliminates

Overpass for crossing road and tracks at Ford Motor Co. Willow Run plant provides access to second-floor rooms. Brick structure in foreground is food elevator



This corridor in the basement of the Curtiss-Wright Corp., Airplane Division, factory at Buffalo leads to cafeteria, lockers, toilets and other employee facilities. Ample in width and free from obstructions, it promotes rapid movement.

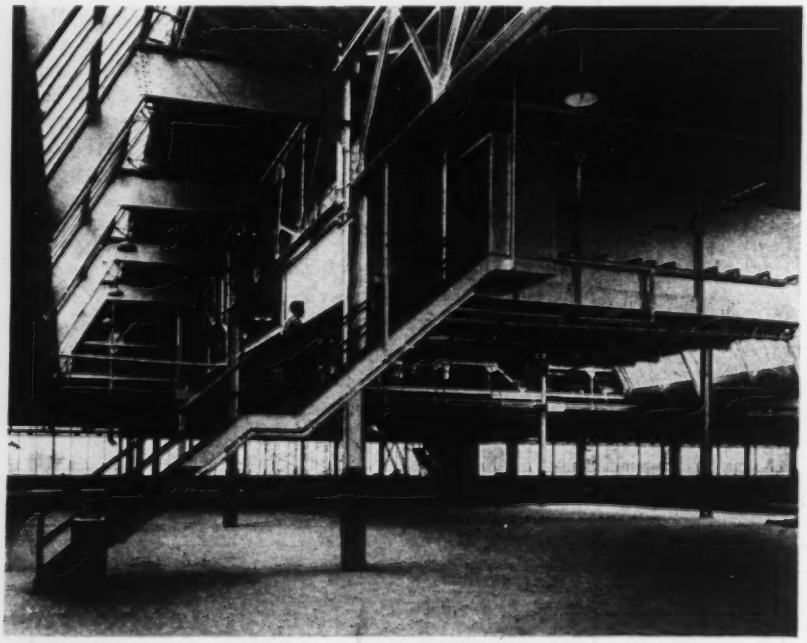
confusion and interruption of operation on the main production floor, obstructions to flexible layout of operations, and obstacles to uninterrupted expansion in any direction.

With facilities completely planned, plant and services will be covered with an exterior that expresses the function of the building. Architectural beauty is largely a matter of proportion and requires no artificial ornamentation to enhance it. Properly treated by expert designers, the modern factory can be made a thing of beauty for no greater cost, Mr. Miehls says, than would be involved in the application of materials in a haphazard, unplanned manner. The value of such application of sash, brick and other exterior wall materials to produce a factory of substantial beauty is obvious.

In general, the structural frame of the future factory, Mr. Miehls believes, will be a skeleton of steel or concrete with columns spaced as widely as possible consistent with cost. The building will be insulated with one of the better insulating mediums available, and while the insulation provided will be an item of considerable investment the owner will be able to recover it within a year or two through the decreased initial and operating costs of his heating system.

Also, in the new industrial plant, greater attention than heretofore will be paid to the interior painting, it being recognized more and more that seeing is not entirely benefited by more light. Foot-candle light level is, of course, important, but seeing is also largely a matter of perception and of visibility. These latter two can be improved by the proper selection of color.

Colors should be chosen with a view to eliminating contrasts. The color of walls and of the ceiling should melt into the background, and not clamor for attention, distracting the man at his work.



Location of employees' facilities on the mezzanine was found convenient in the Chrysler Corp., Dodge truck plant at Detroit, Mich. Here, too, large clear floor areas permit maximum flexibility in production layout.

Rapid Field Test of Bituminous Mixes

M. A. VerBrugge
Materials Engineer Wyoming State Highway Dept. Cheyenne, Wyo.

***Contents in Brief**—Simplified method of determining the oil content in oil-gravel road mixtures gives accurate control in the field, requires only a small amount of apparatus, takes little time to make the tests and requires few computations.*

WHAT IS BELIEVED to be a new and rapid method of determining the percentage of bitumen in bituminous mixtures has been developed recently by the writer, in the materials laboratory of the Wyoming State Highway Department. Although the method is intended primarily for field control of oil-aggregate proportions in designed mixes where traveling plant or road-mix operations are used, it may also be used as a check test when stationary, central or hot-mix plants are involved.

Results of tests to determine the oil content of mixtures based on the Rotarex or New York extraction procedures, formerly used in the Wyoming Highway laboratory, have never proved very satisfactory. Moreover, delays in field sampling and shipping, loss of diluent, moisture content, time required for testing and reporting, and various other factors, leave little if any value to the extraction tests as far as control is concerned.

Automatic control

The newly developed method automatically takes care of the moisture content and absorption of the aggregate. With average aggregates, the time required for testing will not exceed 15 min. With highly absorptive aggregates, not more than 30 min. will be required. Although no field tests have been made to date by the new method, numerous tests have been conducted in the laboratory with excellent results.

Prepared samples were tested by operators, not informed of the oil content, with a maximum error of 0.05 percent. It is reasonable to expect results in the field to be correct within 0.10 percent, providing reasonable care is exercised in sampling and testing.

Equipment used in making the test is neither bulky nor expensive. It includes a thermometer having a range from zero to 220 deg. F.; a 1,000-g. capacity balance sensitive to 0.5 g.; a special flask of the Chapman type, and a hand scoop.

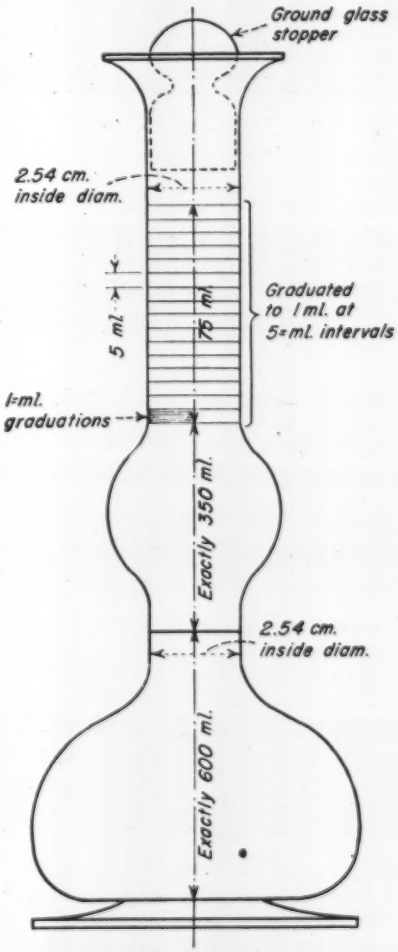


Fig. 1. Chief item of testing equipment is a special two-bulb flask of known capacity with a graduated neck, for measuring the net displacement of a sample of gravel when placed in a kerosene solution, or other approved solvent.

The testing flask consists of two bulbs with a graduated stem, and a heavy base (Fig. 1). The lower bulb has a capacity of 600 milliliters (ml.); the upper bulb, 350 ml.; and the stem is graduated from 350 ml. to 425 ml. in 1-ml. divisions. The inside diameters of the stem and the neck should be at least 2.5 cm.

Test is simple

The procedure followed in making the test is simple and the computations are elementary. The flask is filled to the 600-ml. mark (Fig. 2a) with kerosene or any other solvent of low volatility having a specific gravity within the range of 35 to 50 deg. API (American Petroleum Institute) at 60 deg. F.

The temperature of the solvent is recorded, following which a representative 1,000-g. sample of the unoiled aggregate is taken from the prepared windrow ahead of the mixing operations, and introduced into the flask. After vigorously rotating the flask in an inclined position and whirling it in a horizontal circle until no additional air bubbles rise to the surface, a reading is taken on the stem and the displacement noted (Fig. 2b).

The temperature of the mixture inside the flask is again noted and, if there has been a change exceeding plus or minus 2 deg., a correction of 0.30 ml. is applied for each degree difference in temperature. The correction is added if the latter temperature is lower, or subtracted if it is higher. Results of this portion of the test give the net displacement of the sample of unoiled material.

Oiled sample introduced

The flask is then emptied and thoroughly cleaned, following which a 1,000-g. sample of the oil-mixed aggregate is introduced. This sample is taken after the actual mixing operations have been completed, and at ap-

proximately the same location at which the unoiled sample was secured. Repeating the testing procedure described above, gives the net displacement of the oiled sample.

Calculating the oil content

Having ascertained the net displacement of both the oiled and unoiled samples, the volume, weight and percentage of oil in the oil-gravel mixture are calculated by using the formulas:

$$V_o = \frac{\frac{1\,000\,D_w}{D} - S}{\frac{1\,000}{D} - G_o} \qquad (1),$$

where:

V_o = Volume of oil, in milliliters.

D_w = Net displacement of oiled sample, in milliliters.

D = Net displacement of unoiled sample, in mililiters.

S = Weight of sample, in grams.

G_o = Specific gravity of oil used at the time of making the test.

The percentage of oil, by weight, in the oil-mix gravel can be calculated from the formula:

$$P_w = \frac{W}{1.000 - W} \times 100 \qquad (2),$$

where:

P_w = Percentage of oil, by weight.

W = Weight of oil.

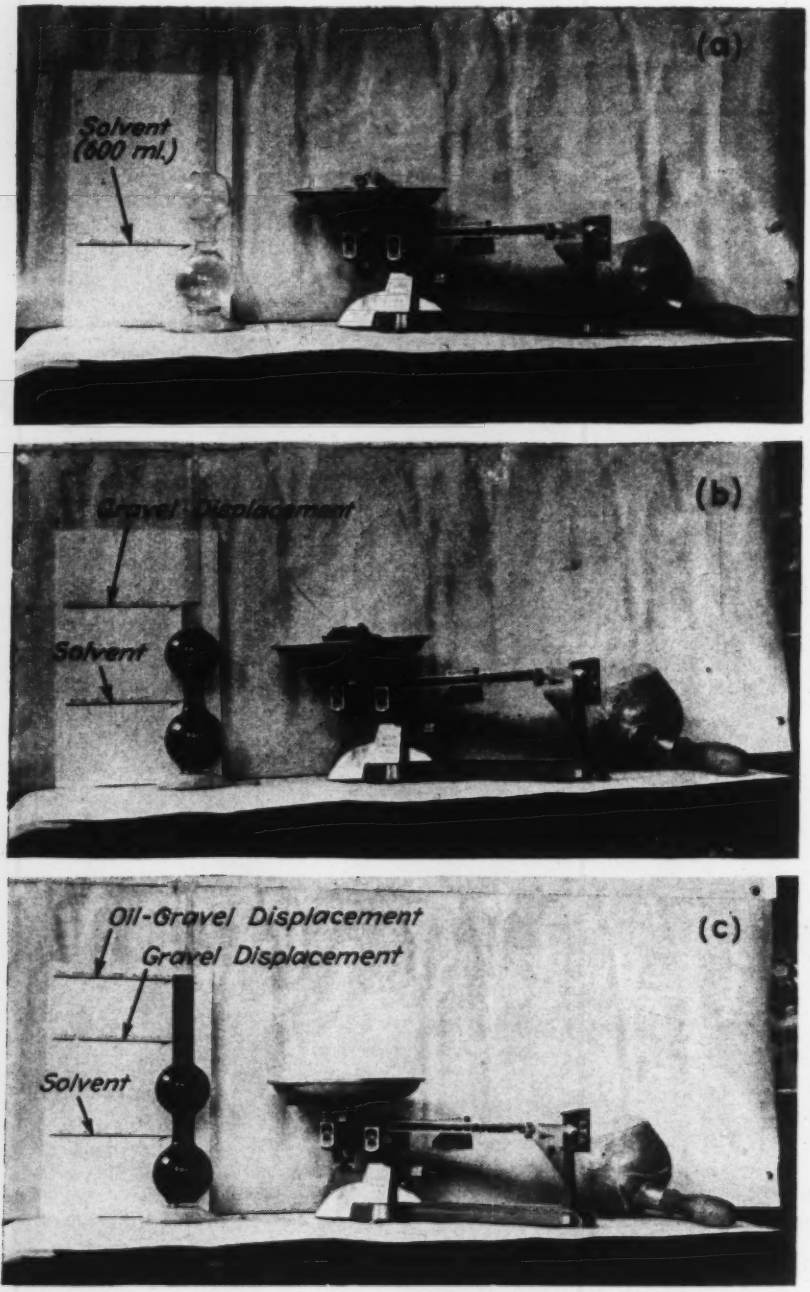


Fig. 2. After placing a known volume of solvent in the testing flask (a), a weighted sample of unoiled gravel is introduced (b) and the amount of displacement noted. The procedure then is repeated using a sample of oiled gravel (c). Note unoiled sample on scales (a) and oiled sample being weighed (b).

The Netherlands Rebuilds Its Houses

Plans to build 60,000 to 70,000 houses annually beginning with 1947 were disclosed recently by the Netherlands Minister of Public Works and Reconstruction in The Hague. Lack of building material, particularly cement and glass, will limit the construction of new houses in 1946 to 10,000. Apart from this new construction, a billion guilders (about 400 million dollars) will be spent to repair and make habitable more than 300,000 houses that were damaged through war activities.

Of a total of one thousand Dutch municipalities, 150 were at least partly devastated, while there are more than half a million persons in Holland who are literally homeless. Houses completely destroyed or heavily damaged total 85,000, while another 35,000 were damaged, but not beyond repair. Of 270,000 houses which were slightly damaged, 220,000 have already been repaired, although their residents are living under extremely difficult conditions.

During 1946, Holland will import 3,000,000 sq. yd. of glass, which will be sufficient for the 10,000 houses on the building program for that year. Holland's production of cement is at present some 30,000 tons a month, but will shortly be increased to 40,000 tons. Before the war one million tons were used each year; half of this was made in Holland and the rest was imported from England, Belgium and Germany.

Holland's brick industry is now only thirty per cent of its prewar capacity. In many instances bricks salvaged from debris are used and it has been found that the rough stones give a very novel and attractive appearance. A new theater being built in Rotterdam is constructed exclusively from salvaged bricks.

Concrete Spiral Stairway Connects Parkway Bridges

A REINFORCED concrete stairway of unusual spiral design connects the two bridges that carry Figueroa St. over the Los Angeles River at the beginning of the Arroyo Seco Parkway. The difference in elevation between the two bridge decks is 26 ft. at this point.

Essentially, the design consists of a hollow reinforced concrete cylinder that supports the spiral stairway by use of keys and reinforcing bars. The bars, which are ½-in. squares, project from the cylinder and form part of the stairway reinforcing. There are four of these bars in each 5-in. tread, two near the top of the tread and two near the bottom; the bottom two are straight, 4 ft. long, embedded about 1 ft. in the wall of the hollow cylinder while the top two are bent at each end for a length of 1 ft. 9 in. One end of the bent bars extends down near the inside surface of the hollow supporting cylinder and the other extends up near the outside surface of the concrete curb that forms part of the stairway handrail. This curb is reinforced with ⅜-in. round stirrups placed normal to the slope of the spiral on 18-in. centers.

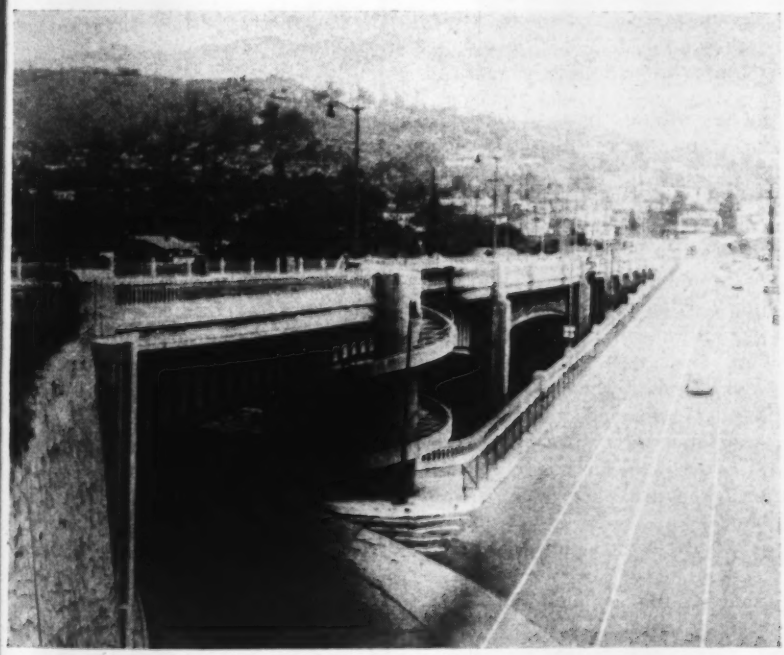
The hollow supporting cylinder has an outside radius of 3 ft. and is 1 ft. 2 in. thick. It is reinforced with ½-in. bars placed as hoops on 12-in. centers near both inside and outside surfaces of the cylinder. Vertical reinforcing is provided by 1-in. square bars, 12 near the inside surface of the cylinder and 24 near the outside.

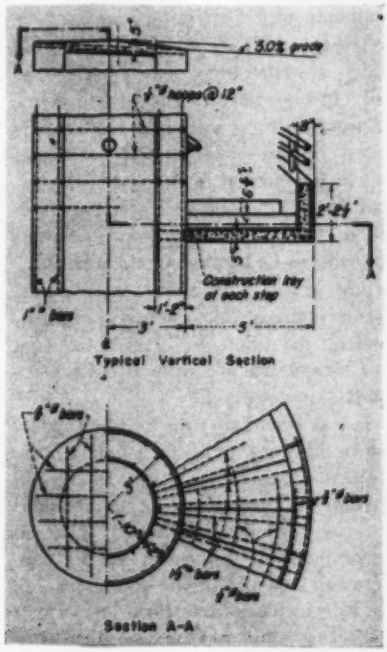
The metal part of the outside railing, which extends 18 in. above the concrete part of this railing (3 ft. 3½ in. above the stair tread), is made up of 2½-in. standard pipe welded in sections, with smooth-ground $\frac{3}{16}$-in. welded joints. Sections are galvanized after assembly. Hand railing on the inside wall of the stairway is made up of 2½-in. standard galvanized pipe supported on brackets at 4-ft. centers.

The hollow cylinder was constructed first, with the horizontal stairway reinforcing projecting from it and with construction keyways indented at each step. The stairway was then poured in sections; forms for the first section were supported on scaffolding on the lower bridge and those for succeeding sections were supported on scaffolding on the section previously completed.

The bridge was constructed under the supervision of the State of California, Division of Highways, Bridge Department, F. W. Panhorst, bridge engineer.

The appearance of the stairway is enhanced by the use of a deep curb and low handrail.





Pedestrian interchange between two Figueroa Street bridges in Los Angeles is effected by the spiral stairway shown in the center of this picture. The stairway is carried by a hollow reinforced concrete cylinder through the medium of ½-in. square reinforcing bars that project from the cylinder and form part of the stairway reinforcing.

Notes from the Waterworks Meeting

● *Equipment operation, process developments and economic questions related to water service were featured on the program of the 66th annual conference of the American Water Works Association, which was held in St. Louis, May 6-10. The following extracts are from those papers of wide general interest that were not reported in a previous news account of the meeting. This earlier report (ENR May 16, vol. p. 764) contained also the names of new officers, recipients of awards and registration information.*

Automatic Chlorine Recorders

AUTOMATIC MEASURING and continuous recording of residual chlorine in water has long been the dream of water purification engineers. Four years ago Chicago installed in one of its pumping plants an automatic residual chlorine recorder, which had just been developed commercially at that time, for the purpose of determining its limitations and reliability. Results from tests on the equipment were sufficiently encouraging to justify plans for their extensive use in Chicago. Three additional installations were added in 1944 and ten others have been ordered, seven of which will be installed in the city's new southside water filtration plant.

These residual chlorine recorders, which are composed of two parts—the cell and the Micromax recorder—work on the following principle: The cell is based on an electrometric principle, in which a current is induced in the cell and tends to polarize a copper electrode. One of its chief features is that the cell can be located almost any place in the plant, with the Micromax recorder being installed at any other convenient location. In one installation in Chicago the two units are 1,600 ft. apart.

It was found that the residual chlorine in the water tends to depolarize the electrode causing variations in the cell current in proportion to the residual chlorine content of the water. The cell current also is influenced by the temperature and pH of the water, as well as by electrode deterioration. There are adjustments, however, on the instrument to compensate for these influences.

"Cell sensitivity", or the number of chart scale divisions equivalent to a unit concentration of residual chlorine, is determined by standard laboratory testing procedure for residual chlorine. The sensitivity can be adjusted to fit a wide range of residual chlorine.

Tests of the equipment disclose that combined active chlorine compounds, such as chloramines, produce less cell current per unit concentration of residual than free residual chlorine. Continuous recording of residual chlorine by these installations has shown definite practical value in chlorination control of the Chicago water supply.—*John R. Baylis, engineer of water purification; and H. H. Gerstein, chief filtration chemist, Bureau of Engineering, Chicago.*

New Materials and Equipment

Among several new waterworks products and devices that are now available, or soon will be, are:

Manifold relief valves, consisting of a number of relief valves built into a manifold which is installed as a unit. The relief valves operate at different pressures, eliminate counter surges, and permit smooth operation. There also are new types of sleeve valves which are a modification of the Larner Johnson type valve for altitude control. Construction of these valves permits removal of all parts for repair and adjustment from the body, which remains in place.

A new valve actuator involves a control system for gate valves based on hydraulic control methods developed by the aviation industry. A pump control valve and a modulating float valve, included in an installation of the California Water Service Co., made it possible to defer the replacement of a steel transmission line during the war. The valves reduced pressure surges to a minimum and provided a more economical operation of the system.

Plastics which are suitable for metal protection and which offer resistance to abrasion are available, although many still are in the experimental stage. Then there are silicones consisting of chemically resistant greases, insulating resins, lubricants and rubber-lined substances in which silicon is used to replace the carbon in the compound. These materials are intended for high-temperature service. Electric motors insulated with silicon products can operate at temperatures as high as 350 deg. Possible applications for the water industry may be found in new laboratory and research devices in the electronics field.—*Samuel B. Morris, general manager and chief engineer, Department of Water and Power, Los Angeles; and L. L. Camy, local manager, California Water Service Co., Los Angeles.*

Water Rate Increases

Waterworks are the most essential of all public utilities and, at the present time about 80 percent of the 13,000 water utilities on this continent are publicly owned. Whether publicly or privately owned, they must be maintained and extended to meet expanding demands. This can be done only if the net income from operation is adequate to finance the necessary construction.

Moreover, the normal waterworks is a growing concern. Its annual expenditure for expansion and improvement of services averages $1.50 for each person it serves. This money must be available from revenues after paying operating expenses and fixed charges.

At the present time the costs of operating and maintaining water utilities are rising sharply and the net income available for expansion and improved service is correspondingly shrinking. At the same time, each dollar of the shrunken net revenue will provide only about two-thirds as much new construction now as it would have in 1940. The

net result, therefore, is that water rates must be increased about 25 percent as a national average if the water utilities are to continue to expand and improve their services to the same extent that they have been over the past several decades.—*L. B. Howson, consulting engineer, Chicago, Ill.*

Flow of Water in Pipe

American engineers have gradually narrowed the usage of the hundreds of empirical pipe flow formulas accumulated over a period of some 200 years, to less than a dozen equations. But so far no agreement has been reached on a single "best" formula. The mechanism of resistance to flow of fluids is quite complex. Except for velocities below practical limits, no definite law of friction-velocity-diameter relationships has been evolved that even approaches simplicity. Moreover, it has not been possible in the past to agree on a formula and confine experimental work to a search for coefficients.

There are many difficulties in the way of constructing a proper pipe flow formula. The controlling element, theoretically, is surface roughness. There being no absolute standard of roughness, surfaces are classified on judgment. Such a procedure cannot be exact. Also, there are always valves, manholes, angles in alignment, joint effects, and other irregularities that cause variation in results. Despite these several uncertainties, however, several of the pipe flow formulas now in use, within limits, may be considered adequate for practical purposes until something better is available.

Although accuracy is a desirable attribute in any mathematical work, much effort can be wasted in carrying computations to a precision not justified by the basic data. This is particularly true in pipe design.

A comparison of pipe flow formulas currently used, leads to tentative conclusions of interest to the waterworks engineer, as follows:

The older pipe flow formulas are imperfect and are limited in scope, but uncertainties involved in their use are not markedly greater than other uncertainties inherent in the design of water supply systems.

Of the newer formulas, that for laminar flow may be accepted as theoretically exact and that for smooth pipe as accurate beyond practical needs. These formulas are of little use in the design of water systems.

The Colebrook formula (see *Journal*, The Institution of Civil Engineers, London, Vol. II, Feb.-April 1939) for turbulent flow in rough pipes is ideal in its conception, but it requires further substantiation, particularly in the transition zone, and the development of a definite scale of values for its roughness factor, k. At present, practical uncertainties involved in its use are probably greater than for the older formulas. This conclusion applies only to water systems, not to gas lines, oil lines, and other fluid transportation systems for which the old formulas are useless.—*Julian Hinds, general manager and chief engineer, Metropolitan Water District of Southern California, Los Angeles.*

Useful Life of Water Wells

How to maintain, rehabilitate and prolong the useful life of water wells was the subject of a panel discussion, with several members of the association reporting on current practices. Brief abstracts of some of their reports follow:

There is no reason why the average useful life of screened wells should not be 50 years and rock wells as much as 100 years. Drillers, engineers and others engaged in the construction of wells, however, must have a thorough understanding of the fundamentals of groundwater occurrence and well-drilling methods, and provide careful and intelligent selection of well types and screens for the particular ground conditions involved in each individual case.—*E. W. Bennison, office engineer, Edward E. Johnson, Inc., St. Paul.*

Based more on personal observation than on tabulated data, it appears that only a few wells of the ordinary type will fail in less than ten years and the average life should be at least 20 years. For the artificial gravel-wall well, data at hand is insufficient to determine the full, useful life but the point at which half the value of the well has been lost might reasonably be set at 15 years. It should be remembered, however, that variations in design and construction, the nature of the water and the soil conditions, and methods of maintenance can vary the useful life of a well over very wide limits. Although the amortizable life of ordinary wells, as given in the schedules of the U. S. Bureau of Internal Revenue, has been set at 100 years, it is doubtful if many will last that long, and almost all of those now existing will have been retired from service before achieving 40 years of useful life.—*Angus D. Henderson, civil engineer, Bayside, N. Y.*

There seems to be a reluctance on the part of engineers and owners to spend sufficient time and money for tests of sufficient duration to secure a true picture of the groundwater conditions. Also, the error of attempting to wring the last drop of water from the individual well is a common one. Overpumping wells in consolidated formations usually does not result in permanent damage to the well, while in unconsolidated formations it may and very frequently does result in difficult and costly repairs or the total loss of the well. There are many rock wells in northern New Jersey fifty or more years old which have been in continuous operation with no apparent decrease in yield.—*J. A. Carr, superintendent, Department of Water Supply, Ridgewood, N. J.*

About 2,000 new wells are drilled each year in Illinois, and historical records disclose that the oldest recorded well, still in limited use at Fort Charters, was dug by the French explorers in 1754. A recent survey of drilled wells in Illinois disclosed that for wells drilled in sandstone, the average life of unprotected casings and liners is 25 years. The average age of about 80 such wells that were studied, is 27 years. If water level recession could be eliminated, there is apparently no limit to the useful life of a properly constructed and operated sandstone well, except for cleanouts and replacement of liners. It was found that water level recession was the primary cause of abandonment.

The records of 83 municipal limestone wells drilled prior to 1935 showed that of the 62 still in service, the average life is 29 years. One has been in service 52 years. Principal causes of abandonment include: small diameter, casing failure and iron bacteria clogging.

The histories of 320 municipal sand and gravel wells throughout Illinois, showed that the primary cause of failure was overpumpage—overpumpage

of the well, or the well field, or both. The end result is complete clogging of the well screen or surrounding water-bearing formation. Records show that for this type of well, in Illinois, casing and screen corrosion is not a primary cause of failure. Of the 320 well records examined, only 35 wells are still in service. Average life of this type of well is 15 years. The average life of the 285 abandoned wells was about 6 years, although some were in service as long as 45 years. Others failed in less than one year. The significant point of the entire study is that 98 percent of the failures were caused by screen clogging and encrustation, which was induced, primarily, by overpumpage.—*J. B. Millis and H. E. Romine, engineers, Illinois State Water Survey.*

Experience with wells constructed on Long Island, New York, in which the water generally is soft with a low *pH* and a relatively high carbon dioxide content, leads to the conclusion that:

1. Gravel-packed wells in steel casings should have a useful life of 75 years with a screen cleaning and redevelopment when its specific capacity drops seriously;

2. Gravel-pack concrete wells consisting of a string of concrete cylinders threaded on cables to hold them in alignment while placing have been used for only a few years, but they show promise of a long life;

3. Tubular wells, operated as individual units, with proper maintenance should have a life of 50 years; and

4. Tubular wells, operated as group suction should have a useful life of 30 years.—*A. T. Luce, New York Water Service Corp., New York City.*

Corrosion Control

Calcium carbonate scale formation and vacuum deaeration of cold water are two processes for corrosion control that have proven successful in a number of plants.

Corrosion problems, which are the result of contact of water with ferrous and non-ferrous materials, would be practically non-existent if the waters were free of oxygen and other corrosive gases, or if some steps were taken to protect the metal surfaces from contact with these gases. This problem is more serious in industry than in municipal water systems due to the greater velocity of the water circulated and to the higher temperatures usually involved. The greatest single use for water in many industrial plants is for cooling, and when constant reaeration occurs, such as takes place when cooling towers are employed, the corrosiveness of the supply is increased.

Of all the treatments for inhibiting corrosion, calcium carbonate scale is the best-known and the most widely used. There are few natural water supplies in which calcium carbonate exists in a state of equilibrium, and for such waters little or no chemical treatment is required since they tend to precipitate a thin and uniform coating. Success or failure of such treatment depends to a great extent of the adequacy of the control and the maintenance of specific conditions favorable to the formation of satisfactory coating over the metal surfaces.

As a means of corrosion control, calcium carbonate scale treatment has not given universally satisfactory results. Dissatisfaction has not always been due to failure to prevent corrosion. The treatment often stops corrosion, but in so doing forms a heavy deposit that causes greater loss of heat transfer than would have resulted from the products of corrosion. On other cases, the type of scale that is deposited is either porous or bulky and not of the right type to seal off the metal surfaces. Such difficulties are not unusual, but can be avoided by taking into account the factors responsible for the deficiency and by adjustment in the treatment to correct detrimental effects.

Corrective measures include: (1) avoidance of the use of water contaminated with turbidity, oil or inhibitors (such as organic compounds or phosphates); (2) chlorination to oxidize organic inhibitors and eliminate algae and slime; (3) omission of phosphate salts and organic compounds; (4) proper selection and feeding of chemicals.

Frequently in industrial water treatment it is neither practical nor permissible to add corrosion-inhibiting chemicals to the water. For extremely large flows the costs are often prohibitive if chemical treatment is employed. Often such supplies are extremely corrosive due to low hardness or low alkalinity, typical of zeolite-softened or de-mineralized water, or condensate. Vacuum deaeration is particularly adaptable to such water as a practical corrosion corrective measure and equipment of this type is now offered.

Cold water deaerators have been installed to protect the carrying capacity of long water mains, reduce corrosion and maintain heat transfer in cooling equipment, reduce corrosion in process water distribution systems and equipment using zeolite-treated or demineralized water. It is not improbable to foresee its early use in protection of domestic water piping and supply lines.

Initial cost of vacuum deaeration equipment is relatively high in comparison with the initial cost of chemical feeders for other types of treatment. However, maintenance and operating costs are generally less than would be incurred either for chemical deaeration or some of the corrosion inhibitors.—*Sheppard T. Powell, consulting engineer, Baltimore.*

Preventive Maintenance

The value of scheduled preventive maintenance of equipment, as practiced by the St. Louis County Water Co., has proved itself in the trouble-free operation of that company's purification and pumping plants.

Chief objectives of the program are: (1) to schedule the preventive maintenance of equipment on a definite periodic basis, so that the work will be distributed evenly throughout the year; (2) to provide a simple procedure for varying the frequency or nature of the work involved to keep pace with changes in operating conditions; (3) to provide a record of both preventive maintenance scheduled and that completed, for each piece of equipment: and (4) to provide a means of determining the cost of such maintenance.

Under this program preventive maintenance operations and the frequency of performing them are tabulated for each piece of equipment. They are based on manufacturer's recommendations, service conditions and past operating experience. To make the program most effective, a card index system is used showing the work to be done, when it is to be performed and by whom. A calendar maintenance directory is prepared to show the work scheduled for each period of the year, and a maintenance planning committee, meeting weekly, administers the program.—*H. O. Hartung, chemist; and W. Victor Weir, vice-president and general manager, St. Louis County Water Co.*

Leaf-Handling and Disposal Devices Aid Suburban Street Cleaning

Not the least troublesome and expensive problem that confronts municipal engineers is the collection and disposal of leaves that fall on tree-lined streets. Two home-made devices that have facilitated this task were shown at a recent field meeting of the New York—New Jersey Metropolitan Chapter of the American Public Works Association.

"Leaf Hog" built around cotton gin

One of these, called the "Leaf Hog" by its builder, J. N. Marshall, superintendent of public works at Ridgefield, N. J., employs a small cotton gin. The machine, Fig. 1, (left) is pulled along the curb at a speed of about 4 mph, and picks up leaves by suction created by the gin. As the leaves pass through the gin they are macerated and ejected from the discharge pipe into a truck that follows behind. The macerated leaves are easy to handle and are in an ideal condition for composting purposes, it is said.

Mr. Marshall stated that with the exception of the gin his machine was built of second-hand parts found around the public works department shops. The assembly, consisting of the gin and a 10-hp. gasoline engine with V-belt drive, is mounted on an old concrete-mixer chassis. The wide-mouth street-metal pickup throat is provided with an expansion section of flexible rubber pipe so that the pickup can be easily lowered and moved with the aid of a lever. The discharge pipe is also provided with a flexible rubber pipe section for rapid adjustment.

Total cost of the "Leaf Hog" is said to be $500.

A leaf-broom that can be fastened to a truck using a conventional snow-plow yoke has been devised by C. M. Pratt, director of public works, Leonia, N. J.

As shown in Fig. 1 (right) this equipment consists of nothing more than a frame welded up from scrap angle-iron and fitted with seven street-sweeping fiber brooms. A ¼-in. mesh screen is fastened along the back of the frame to hold the leaves while they are being pushed into a pile.

Mr. Pratt stated frankly that the leaf-broom, which cost $100 to build, was still in the experimental stage.

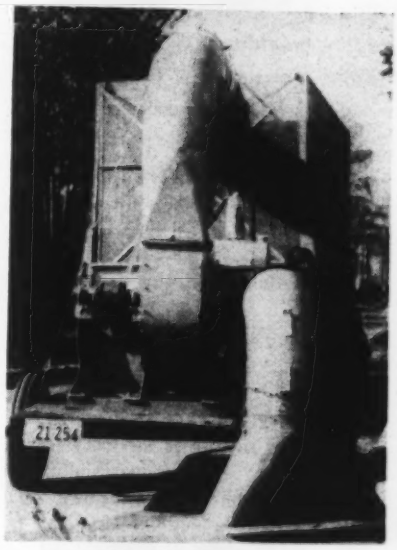


Fig. 2. Vacuum leaf-loader on two-wheel trailer used at Pleasant Ridge, Mich., saves cost of disposal by manual labor.

Vacuum leaf-loader

Recently put into operation in Pleasant Ridge, Mich., a commercially built vacuum loader (Fig. 2) consists of a 30-in. belt-driven fan run by a water-cooled gasoline engine mounted on a two-wheel trailer. An oversize wire-mesh box built on a 5-yd. city truck allows large quantities to be loaded with a minimum of trips to the city dump. While the machine is best used when leaves are dry, it will also pick up sand, dirt, small sticks and stones from the gutter. Normally operated by one or two men, the machine relieves city workers from manual leaf loading.

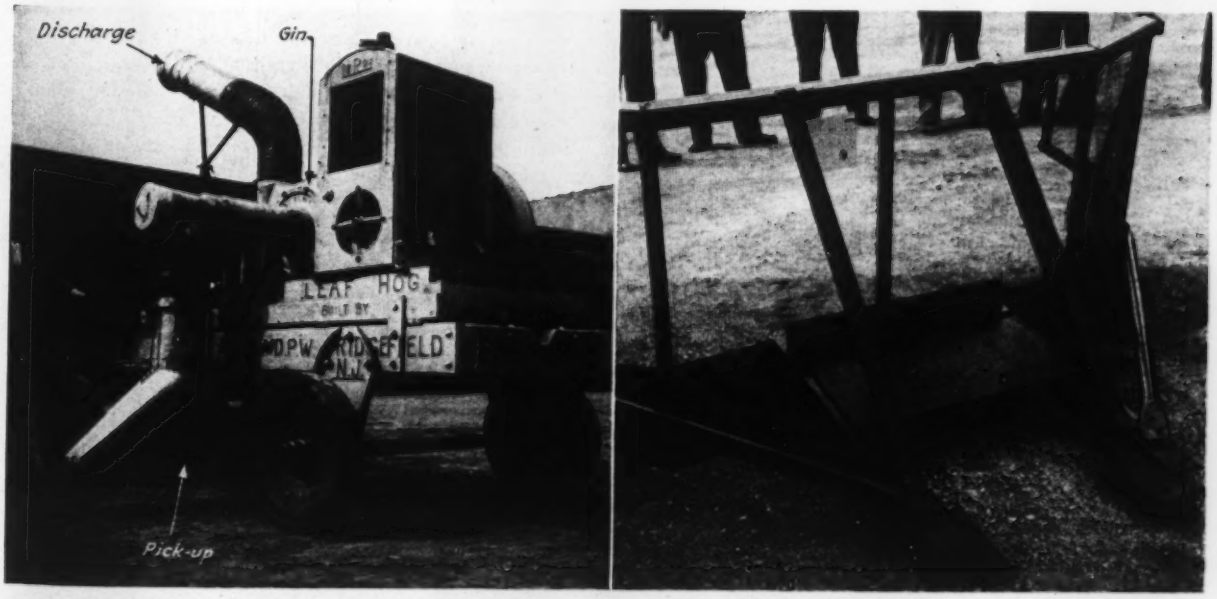


Fig. 1. The "Leaf Hog" is built around a small cotton gin powered by a 10-hp. gasoline engine mounted on an old concrete-mixer chassis. Right: A shop assembled leaf-broom built with scrap angle-iron welded together and fitted with seven fiber brooms. Rear view shows ¼-in. mesh screen for holding leaves while rig is pushed by a truck with a snow-plow yoke.

Cantilevered Concrete Trusses Provide Open Working Areas in Hangar

Arthur J. Boase
Manager, Structural Bureau, Portland Cement Assn.

***Contents in Brief**—Because of the low ratio of height of hangar to height of door, the large clear floor areas and the great amount of usable space provided by the Caquot hangar, the Brazilian Aeronautics Department chose to build this type at the Santos Dumont Airport in Rio de Janeiro. A major structural feature of the building, used to achieve these characteristics, is the cantilevering of concrete roof trusses on either side of central rigid frames. Other significant details of this unusual structure are described by Mr. Boase, who inspected it during his tour of South America for Engineering News-Record.*

ALIGHTING from my plane at Rio de Janeiro's Santos Dumont Airport, I was confronted by an amazing hangar, which instantly reminded me of an experience in France just before the war. Before my arrival in that country, I had heard much about the French engineer Caquot that made me anxious to meet him. When I finally did, the visit proved very worthwhile. He was a dynamic person of many interests, but I was especially intrigued by his discussion of hangars.

Caquot had made intensive studies of the subject, and he produced drawings with many original, inspiring ideas. Unfortunately at the time, any structures of the type shown on his drawings were far from my route of travel. Thus, I left France without visiting the four hangars, now known as the Caquot type, that were then in use.

The hangar at Rio (Fig. 2) was so like the drawings I had seen in Caquot's office that I was certain he must have been the designer. However, inquiry proved this not to be the case, for the job was designed by Fragoso and Ness, a well-known firm of consulting engineers in Rio. Later I visited the job with Mr. Fragoso and obtained from him first-hand the story of the job.

Evolution of hangars

Early in the development of air transportation, the predominating type of ground plan for hangars was rectangular and only one of the smaller sides, generally turned toward the flying field, was open. With the increase in the dimensions of planes, it was necessary to add to the length of this small side, making the plan almost square. Maneuvering of planes inside the hangar, principally the operation of removing one and the accompanying movement of stored planes to permit this, required ever-increasing dimensions of the ground plan, and eventually this necessitated a form wider than deep.

This plan, with its great functional advantage, created the problem of covering large surfaces but retaining a minimum of intermediate supports, and the structural types employed for the solution of this problem have been varied. Often, the supports have been placed in the periphery or arranged in the interior on a center line. In some cases, they have been placed at isolated points. Roof structures, generally framed parallel to the main entrance, have consisted of hinged arches with or without elastic ties, fixed arches, rigid frames with one or more spans, and trusses or girders.

The Brazilian Civil Aeronautics Department, sensing a changing trend in hangar design, sent one of its engineers to Europe to make careful studies of the principal airports of that continent.

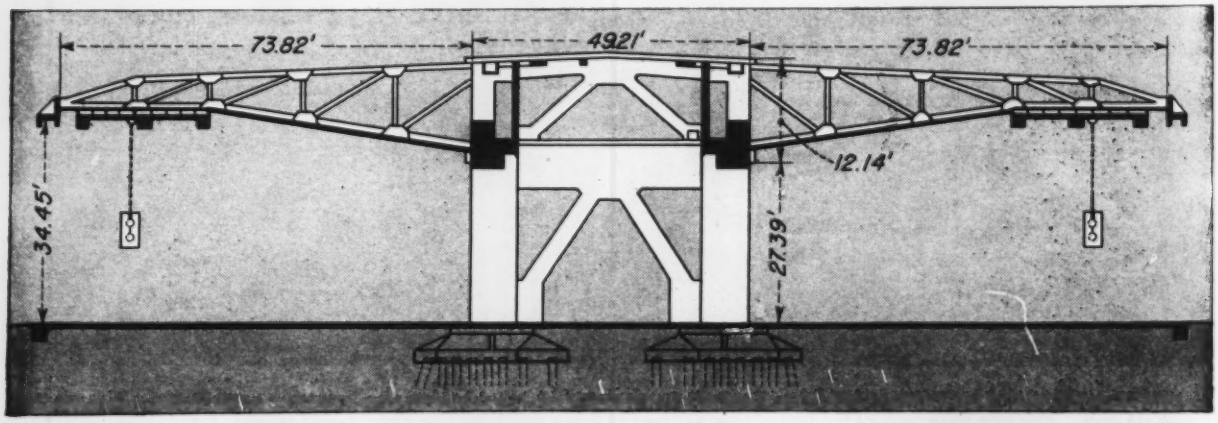


Fig. 1. This transverse section through the hangar indicates the large clear floor area on each side of the central section.

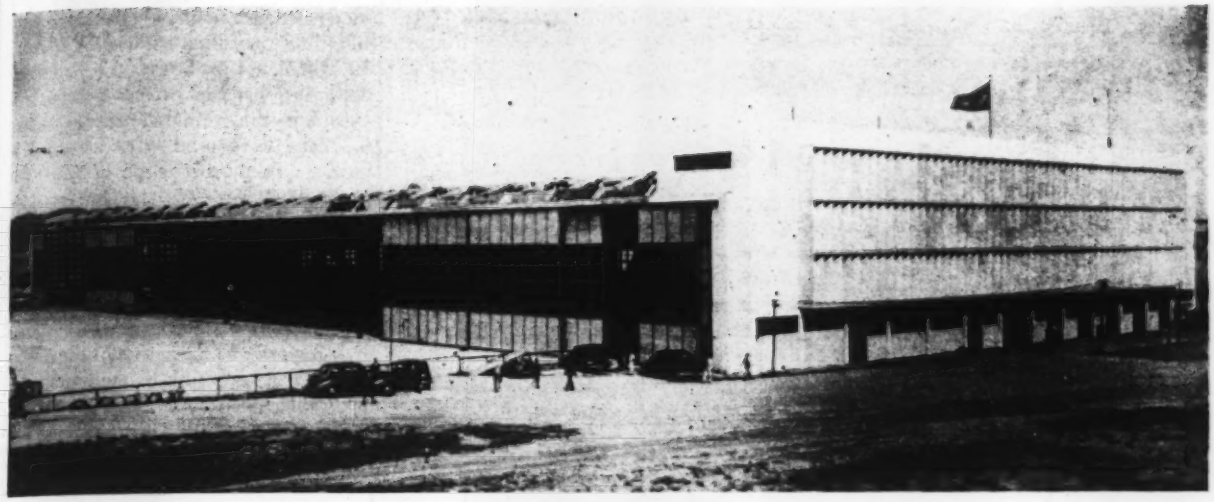


Fig. 2. Cantilevered concrete trusses extending above the roof, make possible unobstructed entrance to Santos Dumont hangar.

After his inspection in which he paid particular attention to the newer hangars in use, this engineer reported in 1938 that while the Caquot type might not reach the ultimate in the evolution of hangar design, it did have certain advantages over other types. He regarded this design as presenting outstanding possibilities based upon three major considerations: (1) The possibility of practically indefinite increase in wing spread; (2) considerable reduction of the ratio between total height of the hangar and height of the door; and (3) provides a high coefficient of usable space for parking and maneuvering as compared to the total enclosed area.

Mr. Fragoso, as well as the Civil Aeronautics Department, felt that these attributes were sufficient to warrant the erection of Caquot hangars. In addition, they recognized the intangible assets of beauty in an industrial-type building, which, by the sincerity and daring manifested by exposition of structural elements and by purity of line, awakened an emotion and thus accomplished an architectural feat.

They felt they could say, as did Freyssinet of the d'Orly hangars: "The strength of the effects obtained is measured by the absence of artistic intentions. It originated exclusively from the ideal of perfection that its creator set for a goal and sought to obtain, free from any other intentions."

Adjoining a four-story, stone-faced Ministry of Aeronautics office building that fronts on Perimetral Ave. (Fig. 2), the Santos Dumont hangar is rectangular in plan, 415.21 ft. by 196.85 ft., with the long side perpendicular to the runway.

In the longitudinal direction, the hangar is divided into four equal and independent units, separated one from the other by expansion joints. In the transverse direction, there is a central section with a width of 43.96 ft., center-to-center of columns, flanked on either side by a 73.8-ft. clear floor space under cantilevered concrete roof trusses (Fig. 1). Providing a clear height at the entrance of 34.45 ft., diminishing to 27.89 ft. at the center section, these trusses project above the roof.

The central portion of each of these independent cantilever units is a concrete rigid frame (Fig. 1) spanning 43.96 ft., center-to-center of columns. The verticals of these frames form the end posts of 103.68-ft. long, concrete longitudinal trusses (Fig. 4, Section A—A), which support seven frames of 44.95-ft. clear span in the central portion of the building as well as the 77.08-ft. cantilevered trusses that extend on both sides.

Unobstructed entrance provided

Suspended at and near the ends of these trusses are concrete beams (Fig. 5), running in the longitudinal direction. Their function is to support 4½-ton capacity traveling cranes, which are used in assembling motors or other plane parts, and to guide the doors.

These rolled-steel doors, supported on wheels along both of the long sides of the building and capable of being extended 415.08 ft., are subdivided into

Photo by G. E. Kidder Smith, New York

Fig. 3. Cantilevered trusses extend above the roof. Crazing seen in foreground occurs in the mastic protection applied to the roof slabs.

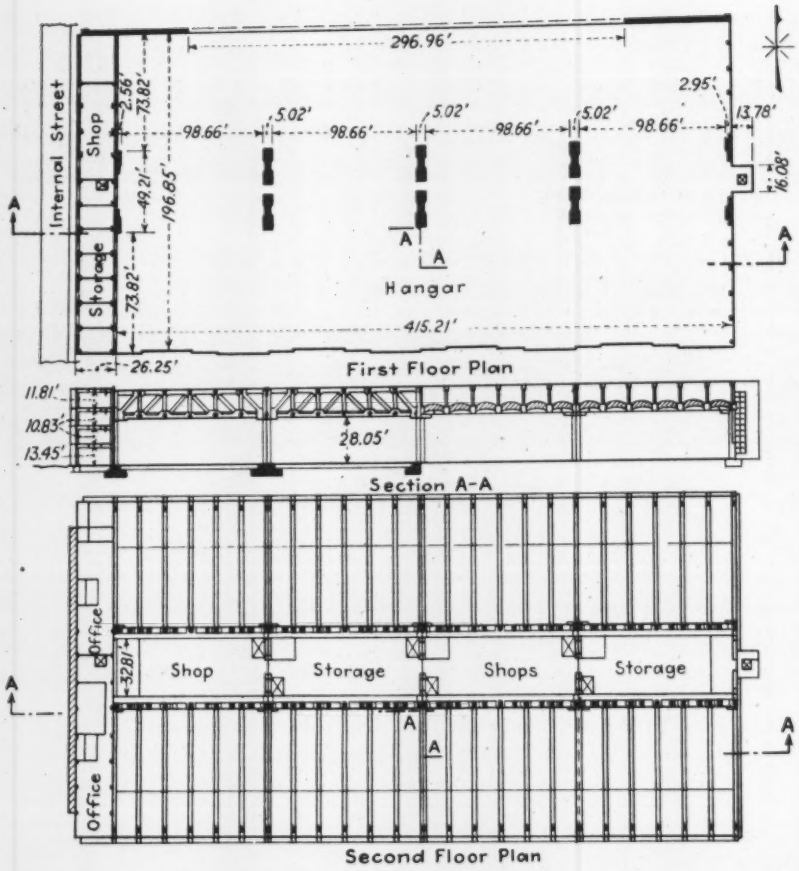


Fig. 4. The large clear floor area of the Caquot-type hangar is shown by the first-floor plan (above). Arrangement of the cantilever trusses and the utilization of space between the longitudinal trusses is indicated by the second-floor plan, while Section A-A shows the longitudinal trusses and arched roof.

24 leaves. The wheels run on three lines of track formed by $1\frac{1}{4}$ x $\frac{1}{2}$-in. welded straps that are embedded in the pavement.

In order to transmit horizontal stress due to wind, steel channels are used at the base. Above the doors, steel channels fixed in a reinforced concrete beam are mounted on a leverage device with springs to prevent the doors from sticking, with possible deformation of the supporting trusses.

The ground floor of the building consists of 8-6½-8-in. reinforced concrete slabs with a usable area of 83,916 sq. ft. The central upper story, with an area of 19,441 sq. ft., is to be used for repair shops, offices and storage space (Fig. 4). According to the designer, this use constitutes another of the advantages of this structural type.

Design of thin shell roof

Supported on the lower chord of the cantilever trusses, reinforced concrete arches spanning 17.26 ft. with a rise of 1.64 ft. form the roof (Fig. 5, Section A—A). It is only $1\frac{3}{8}$ in. thick!

Superimposed load on the roof, in addition to its own weight, thermal insulation and waterproofing, was taken for design purposes at 102 psf. The arches were considered fixed, with a span of 14.63 ft. between skewbacks, a rise of 1.51 ft. and a skewback thickness of 3.2 in. The method of elastic weights was used in drawing influence lines for these arches, and two types of loading were considered—one a uniformly distributed load of 205 psf. and the other a single concentration of 410 lb.

At the expansion joint, the thrust could not be balanced by an adjoining arch. Therefore, tie beams were used at 16.4-ft. centers and investigation was made of stresses caused by the deflection of the lower chord of the supporting truss.

The working stress assumed in the reinforcing steel (intermediate grade) was 25,600 psi. All other stresses were in accordance with provisions of the Brazilian building code (*ENR* April 19, 1945, vol. p. 564). The concrete used—5.9 bags of cement per cu. yd., except in the joints of trusses, where 6.7 bags were used—was assumed to have a minimum strength of 3,270 psi. at 28 days.

Concrete truss design

Other loads considered were as follows: On the floor of the upper-story central section, live load was assumed at 1,020 psf. The reaction of the cranes on the trusses acting in their most unfavorable position was taken at six tons. The wind load was assumed acting horizontally on the entire surface of the doors and building at an intensity of 14.4 psf. Temperature variations of —36 deg. F. and +18 deg. F. from normal were assumed.

Mr. Fragoso stated that the Howe type of truss was chosen for the longitudinal trusses because the diagonals are in compression and the verticals in tension. The designer felt that the cost was reduced by this arrangement. Employment of trusses in this case has the advantage of providing better ventilation and light in the second floor office space. The designer also felt justified in using trusses in the cantilevered portion of the building because of the reduction in dead load and the low cost of labor.

One of the disadvantages of the concrete truss, cracking of tension members, was considered at the time of design and it was decided to concrete the tension members after the centering was struck. Since the live load was only about 20 percent of the total, this cracking danger was at least 80 percent removed.

The cantilevered trusses are statistically determinate. The primary stresses were therefore determined by graphic statics, assuming a joint load of 18 tons at the outer end, including 2.2 tons due to the possibility of a door hanging on it, 11 tons on all other lower joints, and $3\frac{1}{2}$ tons on the upper joints. The members of the truss had primary stresses varying from a compression of 234 tons to a tension of 200 tons.

Since the joints of a concrete truss are rigid, secondary stresses may be very high. The designer elected to investigate their magnitude, with some slight approximations, by the Muller-Breslau method (method of angular

variations). In this case the problem is very laborious, since the structure is hyperstatic to the $3(n - 2)$ degree, where n is the number of joints.

After the principal stresses were calculated, the angular variations $\Delta\alpha$ and $\Delta\alpha'$, were computed from

$$\Delta\alpha' = (\sigma_a - \sigma_b)\cot\gamma + (\sigma_a - \sigma_c)\cot\beta;$$

and from them the moment M was obtained from

$$M = \frac{2EI}{L}(2\Delta\alpha + \Delta\alpha'),$$

where E = modulus of elasticity, I = moment of inertia and L = length of member. Since the moments at any joint must equal zero, the joints were balanced by a method of successive approximations. For each approximation the change in the angle was taken as

$$\Delta\alpha = \frac{M}{4\sum\frac{EI}{L}}.$$

The calculations were carried through twice, first assuming that the concrete in the tension members was not in place and that the exposed reinforcing steel had zero moment of inertia, and then assuming that the concrete had been placed and the tension members had a calculable stiffness. By this process it was found that near the joints moments of as much as 34.4 ft.-tons were obtained.

Analysis of frames

As mentioned previously, the vertical members of the transverse rigid frames in the center portion of the structure function as end posts of the longitudinal trusses and the horizontal members as stiff connectors between the two cantilevered trusses. In order to keep the vertical posts from acting rigidly with the trusses, two Mesnager hinges were used to connect the trusses to the posts. Stresses in the frames were calculated using Kleinlogel's tabulations, since all members are of constant moment of inertia.

In view of the great stiffness of the

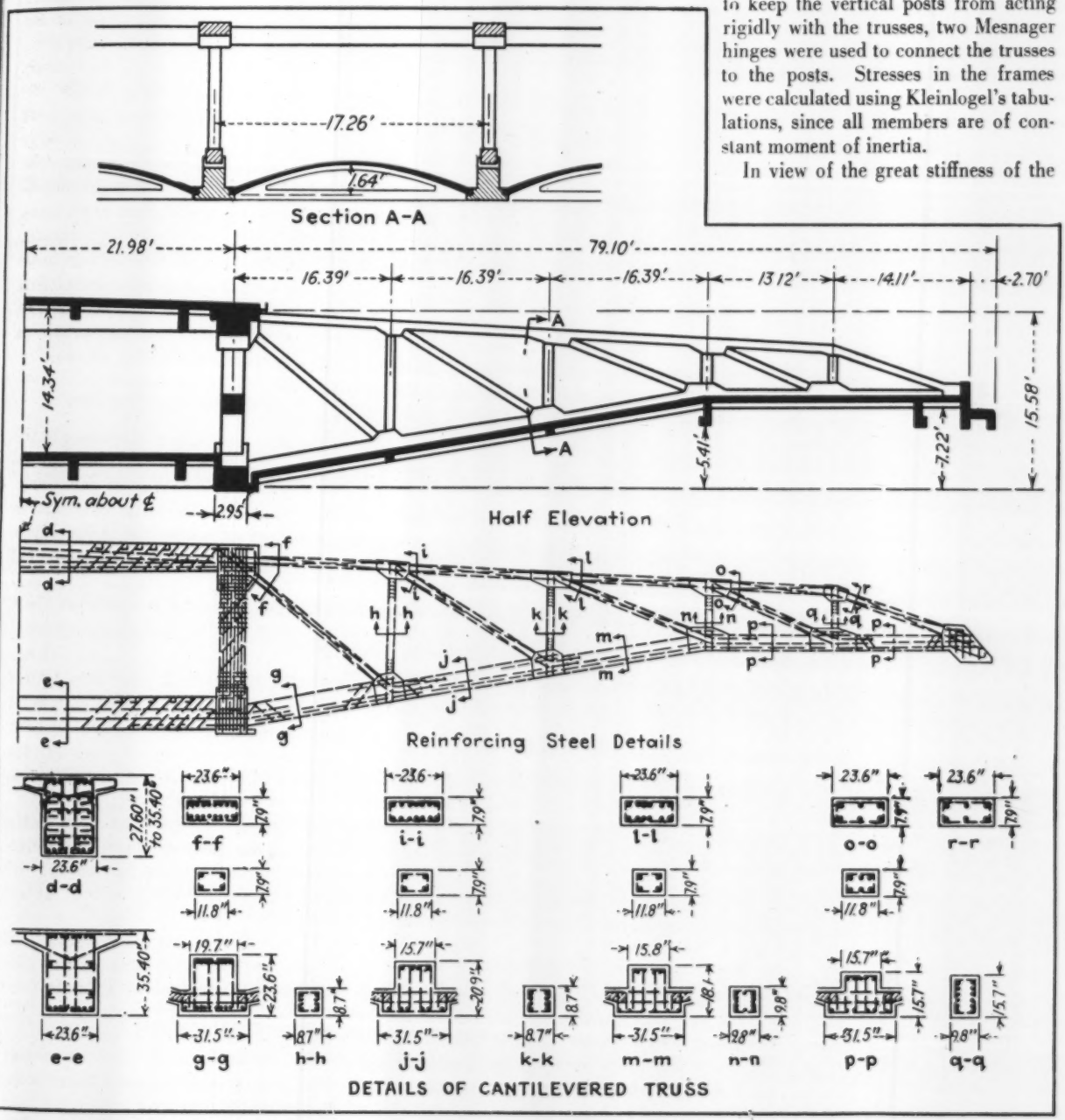


Fig. 5. Details of the cantilevered concrete trusses and section through thin-shell arch roof show the intricacy of the design.

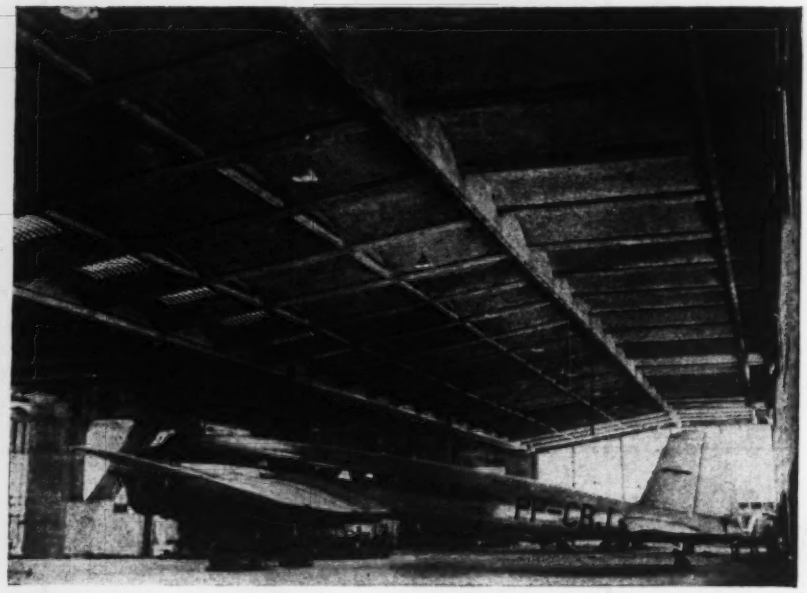


Fig. 6. Under the cantilevered roof is an unobstructed area extending the full length of the hangar between the concrete frames that support the roof (left) and the doors, which are at the extreme right.

longitudinal trusses in relation to the columns of the rigid frame, it was at first assumed that with regard to the principal stresses, the longitudinal trusses could be computed as statically determinate. Later, stresses were calculated as outlined for the cantilevered trusses, and a satisfactory solution was obtained in the fifth approximation. As a construction expedient aimed at eliminating tensile cracks, as far as practicable, the lower chord of this truss was not cast until the centering had been removed.

The cantilevered trusses under symmetrical load were equilibrated in the central frames. However, when the live load is unsymmetrical, for example, due to cranes or wind, the roof slab and second floor are assumed to act as two horizontal beams transmitting the horizontal pull through diagonals to the foundation.

Subsurface conditions

The design of the substructure was based on soundings made over the site to determine the geological profile of the underlying formations. It was found that there were successive layers of clay, muddy sand, loose sand, and finally a sand clay in strata of variable thickness ranging from 10 to 32 ft. Rock in the form of decomposed gneiss was reached at a depth of about 130 ft. Therefore, it was decided to use piles of a type in which a charge of dry concrete encased in a tube is driven to a desired depth, following which the tube is removed while additional concrete is placed. These piles varied in length from 48 to 78 ft.

The load was distributed to the piles by means of a concrete cap, and the amount of load that each pile received was determined by approximate methods assuming a trapezoidal distribution. When the most unfavorable load in the two principal directions, considering wind as well as other loads, was determined, the load on each pile was computed assuming it to carry only normal stresses.

The foundations in the central portion of the structure consisted of clusters of 16 piles, 12 vertical and 4 inclined, the vertical piles each carrying 99 tons. In addition, as a precaution in case only one section of the building were constructed, the footings were tied together in the longitudinal direction by tie beams capable of absorbing and distributing the horizontal thrust.

Construction procedures

The concrete used in this structure was proportioned rationally, and the designer states: "The results of the tests were excellent and showed appreciable uniformity of 4,200 psi. at 28 days."

The following order was adhered to in concreting: Footings; columns of the longitudinal frame up to the lower part of the trusses; joints of the trusses, lower beams of the central frame, with strip of the floor slab with construction joints midway between the two frames; diagonal, vertical and upper chord members of longitudinal trusses; upper beams of the central frame and the entire covering slab with construction joints midway between frames; lower chord, joints and verticals of the longitudinal trusses and connecting beams of the upper chords of the trusses; after striking centers, the arch-type roof, tie beams and door beam; and finally, tension members of the trusses.

To avoid any bars of the tension members being overstressed or receiving a differential stress, they were bound together by threaded U-bolts fitted with a cross plate and nuts. The nuts were then screwed up so that all reinforcing members were under some stress at the time of placing concrete. The falsework of the trusses was made up of timber posts braced by ¾-in. round rods running diagonally, with each vertical member supported on jacks bearing on concrete blocks.

Care used in decentering

To prevent reversal of stresses in the cantilevered trusses, special studies were made for lowering of the centering. Initially, the elastic deformation curve was computed for these trusses by means of a Williot diagram, and from these calculations the theoretical deflection of each joint was determined.

A graduated dial with sixteen divisions representing a full turn was fitted to each jack, which was then turned by means of a lever so that each joint was lowered in proportion to its theoretical deflection curve. In all, the jacks had to be lowered in five operations to free the centering.

When the designer was explaining this unique method to me, our Portuguese and English got all tied up. He told me he was the "Columbus" of this scheme.

After the supports were removed, the measured end deflections of the cantilevered trusses varied from 0.76 to 0.91 in. The computed value was 0.97 in.

Following removal of the centering for these trusses, wooden forms for the arches of the roof were suspended from the lower chords of the trusses. The

reinforcing steel in these thin arches consisted of one layer of $\frac{3}{8}$-in. rounds as distribution steel and two layers of $\frac{3}{16}$-in. rounds as main reinforcing. Since the total thickness was $1\frac{3}{8}$ in., the covering or protection was only $\frac{5}{16}$ in. The top surface of the arches was covered with a mastic as waterproofing (Fig. 3)

Mr. Fragoso and I were in the hangar, on it and around it several times. I had an excellent opportunity to inspect the tension members of the many trusses and the thin-shell arch slabs, as well as to observe the absence of difficulties that so many fear with working stresses in the reinforcing steel of 25,600 psi. Considering that the building has had several years of actual use, I can say that I believe any critical observer would pronounce this job a most excellent one—and it has required practically no maintenance.

It is doubtful, with our labor costs, whether we would find truss construction economical. The trusses could be replaced with girders at less cost in our country and with little loss of utility.

Photo by G. E. Kidder Smith, New York

Fig. 7. Doors roll on wheels along both of the long sides of the hangar. Provision is made for cranes on under side of longitudinal girders located near entrance.

The Santos Dumont hangar is a splendid example of careful, thoughtful design and of excellent construction practice.

Mr. Fragoso should be complimented for the patience, technical skill, knowledge of construction problems and faith in available materials that he showed on the execution of this difficult piece of work.

Two-Way Radio Saves Human Lives and Highway Dollars

A vivid account of the saving in lives and money made possible by installation of two-way radio telephones in highway maintenance equipment was given by W. Bruce Chilson, county superintendent of highways, Chautauqua County, N. Y., at one session of the American Road Builders' Association's annual meeting held in Chicago, Jan. 14-17.

In the snow belt, two-way communication between snow removal units and headquarters has meant the saving of lives of both stalled motorists and highway employees. In all regions, the radio telephone has made possible an increase in operating efficiency far outweighing the expense of installation.

As reported by Mr. Chilson, his county in 1941 had 36 units, about 60 percent of them hired trucks, for snow removal on a 700-mi. system. The war reduced the fleet to 24 units. Radio communication enabled the smaller number to keep the highways open and safe for travel, although the winters were just as severe. Radio made it possible to dispatch equipment instantly wherever needed; there was no lost motion.

On the point of lives saved, Mr. Chilson read a letter from a town supervisor who originally had opposed the county's purchasing of radio equipment. Stranded on a highway with a group of a dozen cars in a blinding blizzard which made it unsafe to leave the vehicles, this man and the others in the stalled conveyances were saved from the danger of freezing to death when the county superintendent found them in their perilous position. He immediately communicated by radio telephone with snow plows in various parts of the county until he got in touch with one which was available to open the road for the trapped motorists.

That experience converted the town supervisor from an opponent to an advocate of the radio communication system.

Speaking of the technique of snow removal, Mr. Chilson recalled the former procedure of assigning heavy plows and rotarys to the highways known to accumulate deep drifts. Results were not satisfactory; the slow-going equipment operated about 30 percent of the time.

With radio, lighter and faster plows cover the road and skirt the deep drifts. The drivers notify the dispatcher of the location of each drift, and the dispatcher sends a rotary to the scene. Several years' experience has proved the economy of this radio control.

In recognition of the vital service given by two-way radio, the Federal Communications Commission has allocated ten frequency channels for highway department use. Mr. Chilson declared there is no question today regarding assignment of sufficient frequency allocations to take care of highway needs.

Radio is a great builder and maintainer of morale, in his opinion. No matter how difficult the highway work may be at times, or how great the dangers, the equipment operator knows that he has only to lift his microphone and aid will be on its way in a matter of minutes.

Concrete Pipe Sections Jacked Vertically Provide Machinery Foundations

J. B. Hoffmier
Project Manager, Wigton—Abbot Corp.
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***Contents in Brief**—Large concrete pipe was forced down by jacking against the frame of a building to permit construction of foundation below those of the building footing. By excavating inside the pipe and (when friction stopped progress) "rocking" the pipe by working each of three jacks separately, four 5-ft. dia. casings were put down 12 ft. at a cost of $433.*

JACKING CONCRETE PIPE 12 ft. down into the ground inside a building to permit placing supports for heavy machinery well below existing foundation was a construction expedient that saved time, money and working space for a rubber tire plant. Foundations were required for four vertical vulcanizers or pot heaters after the building foundation had been completed and the structural steel erected. Each pot-heater unit consists of a ram and cylinder 17 ft. long, weighing 21,000 lb., and other machinery weighing 27,000 lb. The cylinder extends into a pit and the top of the unit extends through the second floor. The entire assembly is about 6 ft. in diameter by 31 ft. long.

The original plan for this installation called for setting the ram sections in circular openings in concrete box foundations 28 ft. long, 6 ft. wide and 14 ft. deep. This was to be constructed within 7 ft. of the foundation wall of the building and the bottom of the box was to be 6 ft. below the column footings. Installation of this foundation by the conventional method would have required sheeting the excavation and shoring the nearby building foundations. In addition, particular care in backfilling would have been required for this method as well as use of 2,000 sq. ft. of forms and 35 cu. yd. of concrete.

The contractor devised an entirely different method of construction that required a minimum of floor space for operation and permitted all other work,

Jacks reacting against the second-floor steel were used to push 5-ft. dia. concrete pipe 12 ft. into the ground. At right, interior form is ready for placing concrete.

including laying of brick sidewalls of the building, to continue without interruption. This method consisted of setting a shell of 4-ft. long sections of 5-ft. dia. reinforced concrete pipe with tongue and groove joints and jacking the pipe vertically to the proper depth, after which a concrete base and the inner lining were placed.

Three jacks used

Jacking the pipe down into gravelley clay was accomplished with the aid of a three-leg jacking frame made of 4x4-in. lumber laced with 1x6-in. boards and supported from, as well as blocked against, the second floor steel. Between the jacking frame and the pipe, three hydraulic jacks were placed, and by jacking against the second floor steel, the casings were pushed down to the required depth. Jacking was handled by three men while one man worked inside the pipe, keeping the excavation at the same pace as the jacks.

Pipe sections were jacked down at the rate of one foot per hour. Small boulders sometimes delayed the operation until they could be dug out and the area outside the pipe backfilled and tamped. On several occasions, skin friction between the earth and the exterior of the pipe created sufficient resistance to stop progress. This was overcome by alternate jacking on each of the three jacks, which created a slight rocking motion and tended to overcome this particular difficulty.

TIME AND COST FOR JACKING AND EXCAVATING FOUR CASINGS

	Man Hr.	
Set and move jacking frame	48	$60.00
Set pipe sections	36	65.00
Jacking	120	140.00
Excavation	126	126.00
Excavation below casing	32	32.00
	362	$433.00

Horizontal alignment was checked by a plumb line and a wooden square made to fit inside the pipe. A spirit level was fitted to the square to check the vertical alignment.

As soon as one 4-ft. length of the concrete pipe had been jacked to ground level a second length was placed on it, and the jacks used to push it down. When the required three lengths of pipe for one heater unit had been set, the soil was excavated to a depth of 12 in. below the bottom of the pipe and slightly undercut. A reinforcing mat was placed in the bottom, vertical dowels were set and concrete placed for the base.

An interior form, 36-in. dia. and 14 ft. long, made of 11-gage sheet iron and fastened at the lap by ¾-in. stove bolts, was centered in the concrete shell. Rings of reinforcing steel were set and the concrete placed. After the concrete had hardened, the bolts were cut and the sheet iron inner form was stripped for reuse in the next shell.

The entire operation for one heater unit required a space of less than 50 sq. ft. per casing, which tied up a minimum of floor area. While the first section was being placed, the jacking truss was moved to the second section and the operation repeated. After all four shells were set, the cap forms were built and the top sections poured.

The author has successfully used this method in construction of sump pits where the pipe is jacked into place, the base excavated and concreted—saving form work, excessive excavation and reinforcing steel. The work described was done in a plant constructed for the Pharis Tire & Rubber Co. of Newark, Ohio, by Wigton-Abbott Corp., as architect-engineers-contractors for the Reconstruction Finance Corp. For this firm the author was project manager and E. U. Johnson was field superintendent.

Cities Revise Airport Rentals To Make Facilities Self-Supporting

Airport operation on a self-sustaining basis is the aim of many cities now reviewing their airport leases and contracts with private concessionaires, according to the American Municipal Association.

The interest of municipal officials in aviation has been heightened by the release of hundreds of military airports to municipalities and the Federal Aid Airport bill, (*ENR* May 16, vol. p. 763) which authorizes, but does not appropriate, $500,000,000 for airport development on a 50-50 matching basis with states and cities.

New York City's new airport authority is expected to revise virtually all of its leases with the 13 airlines at LaGuardia Field, as well as some of the leases at still-unfinished Idlewild airport. Authorities hope to boost rentals appreciably in an effort to make the facilities more nearly self-supporting. Re-examination of all leases at Chicago's airport was decided on recently by a city council subcommittee.

Des Moines, Ia., is one city issuing bonds to finance expansion of airport facilities without waiting for federal aid. A second municipal hangar will be built with the bond proceeds and leased to a private operator. Rental on the building will provide for retirement of bonds in 20 years and payment of insurance and maintenance.

Several cities already have new contracts with private concerns in operation. Some $30,000 annually is expected to accrue from rental of four hangars to private concessionaires at the Dayton, Ohio airport. At the Salem, Ore., airport—recently released by the Army—$200 yearly fees are now being levied on commercial operators. Hangar rental has been fixed at 40 cents a month per foot of wingspread.

New rate systems covering private flying schools at municipal airports are generally more comprehensive. Emporia, Kan., flying instructors now pay a $10 fee for the first plane and $5 for each additional plane based on the local field plus storage rates. A one percent levy is made on the purchase price of each airplane sold at Emporia, and office space is rented on a floor area basis to private operators. Louisville, Ky., recently put into effect a new tax on commercial aircraft.

Operation in private hands

Some smaller cities are signing contracts granting private enterprise complete operation of municipal aviation facilities. A new Eldon, Mo., contract, for example, provides for a ten-year lease of the city airpark with options to renew, at an annual rental of $300 plus a 2 cents per gallon royalty on aviation fuel sold.

The Eldon contract is technically "non-exclusive" to allow the city to fulfill requirements for federal airport aid. It also provides for employment of a full-time manager, and guarantee by the operator of service, flight training and equipment at fair prices.

Improved Street Illumination Reduces Accident Rates

STREET TRAFFIC HAZARDS in Los Angeles are far greater at night than in daytime, according to records kept in that city, with the highest percentage of accidents on the poorly lighted streets. To alleviate this condition, city engineers have developed methods of bringing antiquated street lighting up to modern standards. The favorable effect of such modernization has been clearly demonstrated at some installations in only a few months.

Most fatalities at night

It was found that 70 percent of all traffic fatalities occur during the hours of darkness, when traffic is reduced to 28 percent less than normal volume, and that 65 percent of the fatalities are pedestrians. Of the sixteen streets having the highest pedestrian fatality rates in the city, the two with the highest night visibility and the greatest volume of night traffic have a 4-yr. record of the lowest fatality rate per mile. This is cited as indicating that lack of visibility is the cause of most night accidents.

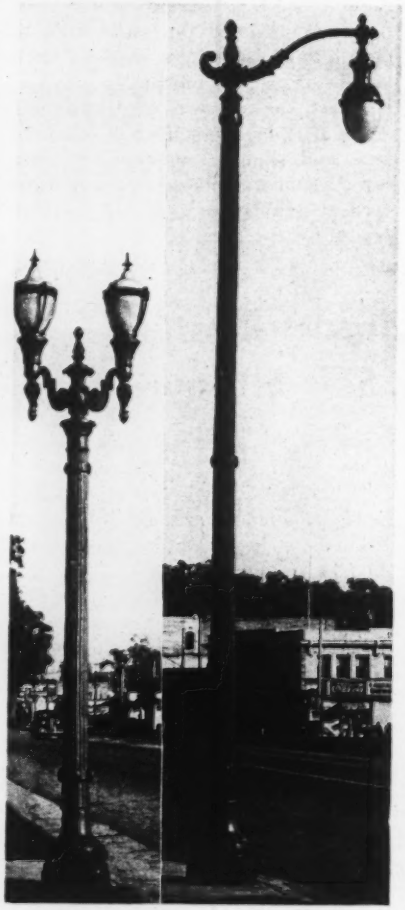
The Illuminating Engineering Society in their code "Recommended Practice of Street Lighting" establishes standards adequate for night safety of streets and traffic arteries in accordance with traffic volume. The classifications medium to heavy traffic require an average lighting intensity of between 0.7 and 1.5 foot-candle in order to provide adequate visibility.

Los Angeles has been attempting to provide adequate street illumination for traffic conditions of 1946 with lighting equipment designed for and well suited to 1920 conditions. Old lighting equipment in the city provides only 0.15 foot-candle or about 10 to 25 percent of the required intensity.

Inadequate lighting system

Although there are some 5,000 miles of streets in the city, 60 percent of all traffic fatalities occur on approximately 140 miles, 100 miles of which are illuminated by obsolete types of curb lighting systems with insufficient lighting intensity. Several intersections, where records show a high accident rate, were selected and the existing lighting equipment was converted to a standard with a single modern lighting unit pendant over the street. Where this has been done impressive results have been obtained. One location in particular showed that, in the nine months previous to improvements, there were nine after-dark accidents, with three pedestrians involved. In the nine months following the installation of better lighting equipment there were only two after-dark accidents, with no pedestrians involved.

The intersection of Sunset Blvd. and Figueroa St., where the same type of improvement was made, in the three months prior to the change had seven after-dark accidents as compared to three in the following three months.



Old lighting standards (left) along many streets in Los Angeles are used to form the lower part of higher standards (right) in modernization of the antiquated street lighting system.

The accompanying illustration is an example of conversion for one type post. The old style lighting standard is on the left and the converted standard on the right. Note that the new standard is about twice the height of the old standard. The extra height is necessary for efficient distribution with modern luminaires, which should be 25 ft. above street level.

Changing light standards

The conversion procedure is first to remove the existing standard and drill a hole in the concrete foundation. This hole is fitted with a casing which acts as a sleeve for a 4-in. pipe. The pipe serves as a core or center for the converted lighting standard and extends the full height of the standard. The lower portion of the converted standard is made from the existing one. A new part is required for the upper half and this can be made of similar design. The pipe core runs through both upper and lower sections, providing structural rigidity. In some cases this general method of conversion is inapplicable as the top or cap for the old standard is cast monolithically with the standard and insertion of the 4-in. pipe core is impossible. In such instances a completely new standard is required.

About 60 percent of some 20,000 lighting units in Los Angeles can be converted. The cost is about $200 per unit, less than it would cost to put in an entirely new standard. Results to date have been good. Maintenance costs are reduced because the cost of repairing such converted lighting standards after suffering traffic damage is less than the repair costs for the obsolete standards.

The estimated cost of converting existing lighting equipment as outlined in the foregoing is approximately $20,000 per mile of streets. The economic loss to the community for each fatality is estimated by various agencies as between $25,000 and $45,000. Fatalities over a four-year period on the 140 miles of streets previously mentioned for after-dark accidents averaged 1.2 per mile of streets. On the basis of these figures Los Angeles engineers conclude that the cost of converting lighting to proper intensity would be more than offset by the anticipated reduction in fatalities.

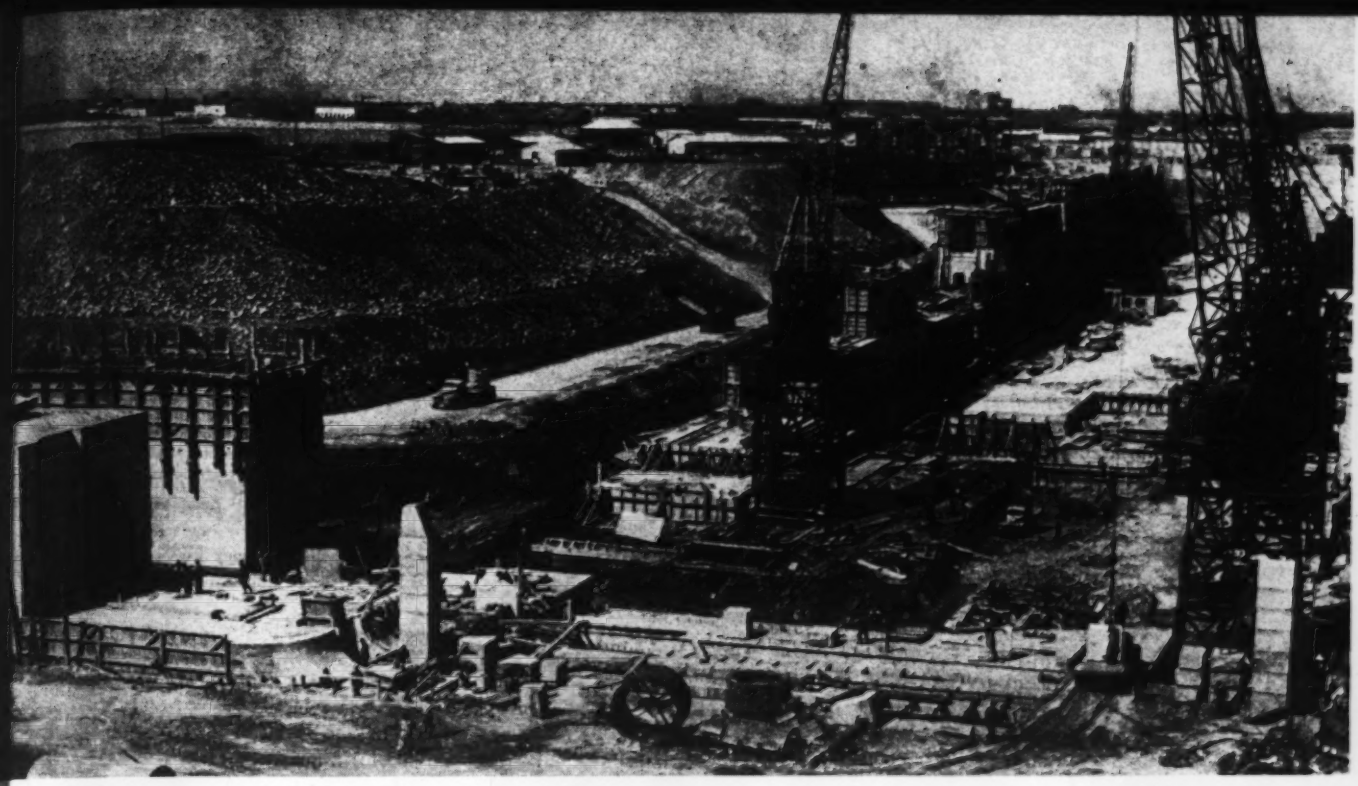


Fig. 1. Traveling steel forms were used for placing concrete in this graving dock at Cape Town, South Africa

Drydock Construction at Cape Town

Charles M. J. W. Kohler

Engineer Manager, The Graving Dock Construction Co.
Cape Town, South Africa

***Contents in Brief**—One of the world's largest drydocks was built in 18 months at Cape Town with concrete placed into traveling steel forms in successive monoliths by large cranes handling 2 cu.-yd. buckets. Grouting was used to seal concrete walls against leakage. The closure gate slides into an adjacent recess while an auxiliary floating caisson may be used as an emergency gate or to subdivide the dock.*

PACED by adequate heavy equipment and a coordinated crew of 300 European and 850 Africans, a drydock with the largest cubic capacity of any in the world recently was placed in service at Cape Town, South Africa, after an unprecedented construction period of only 18 months. The dock basis has a clear length of 1,181 ft., a width of 148 ft. and a depth over the sill of 40 ft. at low water—sufficient to accommodate any ship afloat.

Some drydocks are longer, and some are deeper or wider than the one at Cape Town, but no one of the other large drydocks exceeds its 319,000-cu. yd. water volume.

The dock can be closed by means of a sliding gate or a floating caisson. It can be subdivided into two parts of different lengths by placing the floating caisson in either of the two inner caisson grooves to make a chamber 450 ft. and 725 ft. or 685 and 490 ft., respectively. The floating caisson also can be placed in a groove outside the sliding gate, to make an overall length of dock of 1,227 ft. at cope level.

Cast iron keel and bilge blocks will accommodate a load of 150 tons per running foot along the full centerline of the dock.

Four travelling dockside cranes are permanently located on the walls of the dock, the largest of these having a lifting capacity of 50 long tons at 64½-ft. radius. Ten electrically operated capstans, with a pull of 20 long tons each at 40 ft. per minute, will handle vessels into the dock.

"Dried-out" in four hours

The huge dock can be pumped out in a little more than four hours, using three main centrifugal pumps each driven by a 1,200-hp., 2,200-volt, 3-phase synchronized electric motor operating at 273 rpm. The pumps have a 52½-in. impeller located at 35½ ft. below low water. A 60-in. valve on the intake and a 54-in. valve on the discharge side of each pump can isolate any one of the pumps.

By opening the 7-ft. valve in the two 9-ft. filling culverts, the dock can be filled in about 1½ hours. The times listed for both filling and emptying are for an empty dock; they are reduced

by ships in the dock—the larger the ship the shorter the time required.

The drydock is in the south corner of the new Duncan Dock Basin where there is adequate room to maneuver. At the immediate site earth overlies Malmesbury shale that is in layers at an angle of 27 deg. to the vertical. Some 700,000 cu. yd. of overburden was removed by dredging prior to unwatering the work area, part of the material being dumped around the site to serve as an inclosing berm.

Work in cofferdam

An area of 142,700 sq. yd. (29 acres) was inclosed inside a single steel sheetpile wall 4,800 ft. long. The sheetpiles were 37 to 60 ft. long and were driven 3 to 4 ft. into the shale.

After unwatering, about 210,000 cu. yd. of material, largely rock, was excavated. Four ¾- cu. yd. shovels and five to seven 3-ton dump trucks handled 1,100-1,500 cu. yd. of rock in 9 hr., hauling a maximum of 1,500 ft. for disposal. Rock was drilled up to 15 ft. deep and shattered with 40 percent gelignite using 0.42 lb. of explosive per cu. yd. of rock excavated.

Trenches were cut in the rock, lined with concrete to an 8 x 12-in. size and covered with 2 in. precast concrete slabs to carry surface and seepage water to pumps. Water flowing from vertical seams was trapped and led to the horizontal drains by hollow precast slabs set over the leaks and sealed along the sides with mortar.

Drains for relief of hydrostatic pressure under the floor of the dock were one of the most important parts of the dock construction and were set into the rock at about 30-ft. centers, both longitudinally and across the dock. Longitudinal drains were 12 x 12 in. in size and the cross drains 18 x 18 in. In the trench across the dock, 6-in. glazed earthenware pipes in 2½-ft. lengths with open joints were placed in the trench on a 3-in. layer of 1½-in. stone. Pipes were thoroughly bedded in the stone and covered by 2-in. precast concrete slabs that were joined with a weak mortar to form a completely enclosed trench and prevent mortar from subsequently placed concrete entering the pipe.

Longitudinal trenches were filled with stone only but were covered and sealed with precast slabs. The 6-in. dia. pipes in the drains across the dock are continued vertically inside the walls and cast into the concrete. They discharge into gutters formed along the side of the dock floor.

For removal of surface and seepage water from the cofferdam, two pump stations each were equipped with two 8-in. centrifugal pumps direct-connected with 75-hp. motors. One pump was sufficient to keep the water down, the second acting as a standby unit. For pumping drainage from the permanent installations, two 18-in. centrifugal pumps driven by two 210-hp. electric motors at 730 rpm. were installed—each having a capacity of 2,000 long tons per hour with water at El. 47.50. The pumps were planned mainly for handling water from the relief drains when the dock is being unwatered.

Concrete from central plants

The 350,000 cu. yd. of concrete required for the drydock was mixed at two central plants. Most of the concrete came from the "main" plant equipped with three 2-cu. yd. and one 1-cu. yd. mixer set below ground level. Stone and sand arrived on the site in railway cars. For delivery to the mixer the stone was loaded by excavating machines into movable hoppers standing over a 2-ft. gage track and from the hopper was loaded into dumpable boxes on narrow-gage trucks. Sand was loaded and measured into similar dump boxes and the material transported by petrol-driven locomotives for delivery to the mixer.

Four 100-ton cement hoppers were built above the mixers. The cement, delivered in railway box cars, was picked up with a cement pump and blown through a pipeline a distance of 450 ft. with a difference in elevation of 27 ft. The hoppers were located over the mixers and cement passed through automatic weighing batchers to the mixers. The water also was gaged automatically.

Special concrete with small aggregates (¾-in. and 1½-in. stone) was required for the reinforced concrete and face concrete. A 1-cu. yd. mixer was set up independent of the main plant to provide up to 200 cu. yd. per day of concrete. The stone and sand was measured and delivered similarly to that for the main plant and the cement was measured in bags.

Concrete placing

Before concrete was started the rock surface was cleaned by blowing it off with water and compressed air at a pressure of 90 psi. A layer of cement mortar about 6 in. thick was placed over the rock surface.

Concrete was transported from the mixers to any desired area in the drydock in special 1 or 2-cu. yd. capacity concreting buckets standing on flat-bed 5-ton trucks. The buckets were picked up by 4-ton cranes and delivered to the forms where required.

Buckets used for placing weighed only 1,200 lb. for a content of 2 cu. yd. of concrete. The bucket is a round

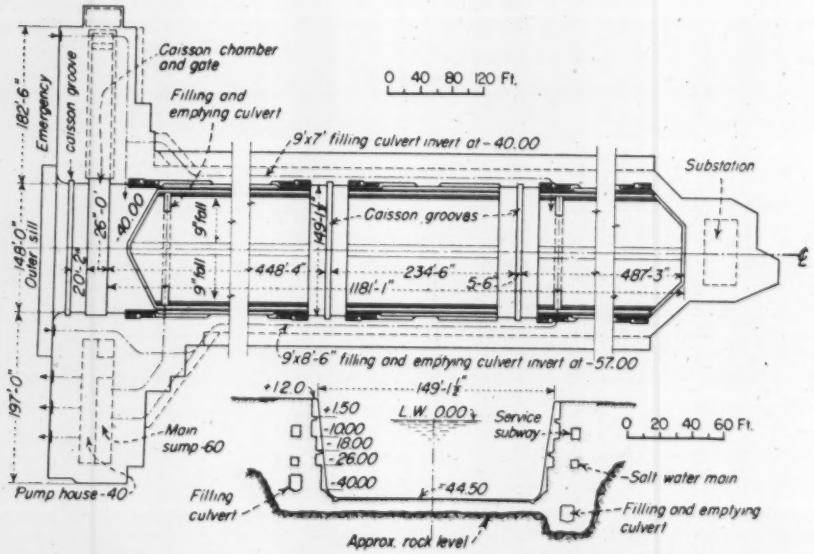


Fig. 2. The Sturrock graving dock will accommodate the largest ships afloat or can be arranged to accommodate vessels in separate compartments by moving the auxiliary gate to one of the interior grooves.

drum of 5-ft. dia. and 4 ft. 2 in. high, which has a conical bottom that can be lowered over a distance of 1½ ft.

The bucket is set down at the desired point of discharge and a catch is pulled by hand, after which the crane lifts the bucket. The catch releases the conical bottom and the concrete flows out. By lowering the bucket again, the conical bottom is pushed back into the drum and, by means of the catch, locked automatically. All the mechanism is enclosed and concrete cannot get into it. The bucket empties vertically so there is no lateral movement while dumping.

The buckets are by far the best ones ever used in this area. They were designed by the engineering staff of the contractor. With 24 of the 2-cu. yd. buckets and 12 of the 1-cu. yd. size, 340,000 cu. yd. of concrete was placed in 15 months and the buckets are satisfactory for additional use.

At the peak of construction over 2,000 cu. yd. of concrete was placed in a 9-hour working day, using 27 trucks and 7 cranes for placing.

Prebuilt steel and wood forms

Main walls of the drydock were placed in successive, rather than alternate, monoliths 36 ft. long and 3 to 10 ft. high.

Movable steel forms were used for the dock walls and for the culverts and galleries in the walls. The forms were designed for a pressure, due to the concrete, from zero at the top to a maximum value of 400 lb. per sq. ft. at a depth of 4 ft. based on a rise of about 1 ft. per hour of the concrete. Maximum deflection permitted in the plates of the panels was *l/500*, and in the walers and stiffeners between the frames of *l/1,000*. Maximum stress in the steel was 18,000 psi. When standing empty, the structure could withstand a wind pressure of 30 lb. per sq. ft. with a maximum movement at the top of ¼ in.

The steel forms consisted of two sides and one end, and were open at the other end. For the first use a bulkhead of timber was employed; after the first blocks had been poured the finished concrete acted as a stop-end to which the sides of the forms were connected when being lined up. Each side of the form rested on two 5-in. round rollers 3 in. wide that moved on the concrete inset at the several altar levels.

Fig. 3. Gantry cranes handle concrete in 2-cu. yd. buckets delivered by trucks from central mixer plant in background.

The movable steel forms for the culverts in the walls also rested on rollers. By loosening nuts of the horizontal struts the sides could be pulled in by turnbuckles, after which the forms were lowered by removing wedges on which they had rested during concreting.

Two types of prefabricated timber forms were used, one for the floor and a separate type for sections of the wall. Due to sloping strata in the foundation, the floor varied in thickness from 6 ft. to more than 30 ft. Form panels for the floor were 12 ft. long by 6 ft. high and were in the form of a horizontal key. Wall forms were made in sections 10 ft. long by 11 ft. high. These forms were built of 6 x 3-in. studs set horizontally at 2-ft. 9-in. centers with vertical lagging 1¼ in. thick and were lined with 22-gage galvenized or black iron, nailed and soldered at the joints.

The timber forms were stripped and re-erected by six small cranes of one-ton capacity at 20-ft. radius powered by a pneumatic winch. Cranes weighed about 6¼ tons including 2½ tons of ballast and were placed on the top of preceding pour by the big cranes.

Prefabricated steel forms were built for 1,848 sq. yd. of surfacing, which was 5¾ percent of the 32,172 sq. yd. on which steel forms were used. About 19,000 sq. yd. of prefabricated timber forms were built, a little more than 20 percent of the 91,000 sq. yd. area for which they were used.

Vertical and horizontal keys

At vertical joints between blocks of concrete, seals were formed by vertical bitumastic joints in all the walls and at the entrance sill to prevent water from leaking between the blocks. Openings for the bitumastic joints were

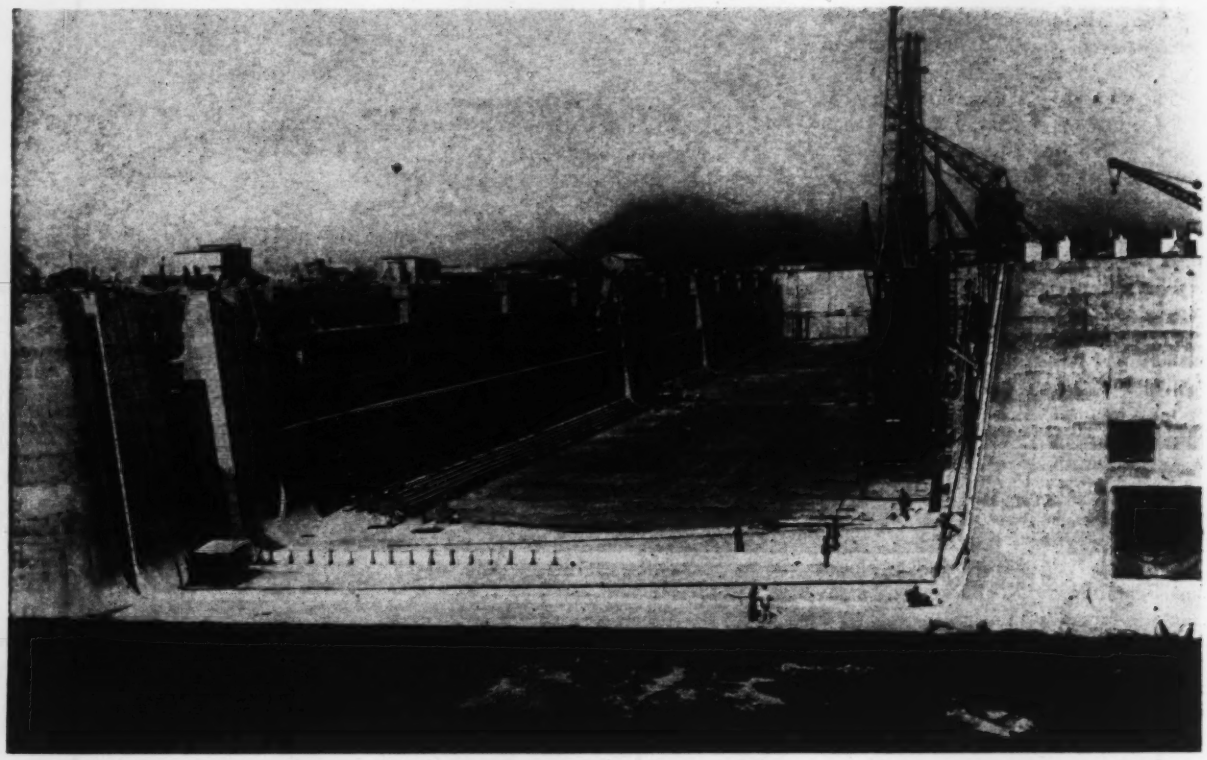


Fig. 4. Nearly completed dock ready for flooding. The cranes were lifted out after flooding by the 50-ton dockside crane. One of the filling culverts is at the right. At the left may be seen a groove for the emergency gate and beyond it the wider opening to the chamber containing the gate used normally to shut off the drydock.

made with precast concrete slabs that had a groove facing the form. After the form had been moved and made ready for concreting of the next block, the same type of precast groove was placed against the first to form a vertical opening. The grooves were painted with hot bitumen and the space formed by the two grooves was filled with bitumen mixed with 10 percent dry asbestos fiber and heated to 250-300 deg. F. At horizontal joints between vertical lifts, keys 8 in. high by 2 ft. wide were formed in the surface.

After flooding of the dock some minor leaks appeared in the pumphouse. Also there were some joints between blocks in the dock walls that were not completely watertight. The bitumastic joint appeared to be satisfactory and it was reasoned that the leak must be caused by local honeycombing in the concrete.

Grouting stops wall leakage

Leakage through the joints and the walls were completely stopped by pressure grouting. A hole about 18 in. deep was drilled with an air hammer into the joint and in this hole a 1-in. grout pipe was placed and caulked. A mixture of neat cement and water was forced into the pipe by compressed air. Grouting was started with a pressure of 20 psi. and was gradually increased to 70 psi.—sometimes finished off with a final shot with the full air pressure of 90 psi. After grouting the pumphouse and the few places in the walls, the whole construction was absolutely watertight.

Record in construction

Excavation was started in September, 1943 and the last concrete placed in March, 1945, so that it took only 18 months to carry out the contract. This is believed to be a world record as regards the building of large graving docks, all the more striking when it is considered that construction was done during wartime, when many shortages were encountered.

Much credit for this record is due to the wholehearted interest of the men.

The work was carried out under the general control and direction of the chief civil engineer, South African Railways and Harbours, Union of South Africa. The plans were prepared by the Office of the Harbour Advisory Engineer, Col. D. E. Paterson.

Dredging of the 716,000 cu. yd. prior to closure of the cofferdam was done by Hollandse Aanneming Maatskappy (The Netherlands contracting firm that built the Duncan Dock at Cape Town).

The drydock was built by the Graving Dock Construction Co., a combination of South African construction firms, for whom the author was engineer-manager. H. H. Green was deputy engineer-manager.

The total cost of the dock was £3,510,000. The value of the lump sum contract carried out by the Graving Dock Construction Co. was about £800,000. This contract included the layout of the work site, erection of the installations, excavation of 210,000 cu. yd. of rock and placing 350,000 cu. yd. of concrete with all work incidental to the major construction.

Sand, stone, cement and 2,000 tons of reinforcing steel were supplied to the contractor by the South African Railways and Harbours Administration and the British Admiralty. The permanent equipment was supplied by the British Admiralty.

Piles and Pile Foundations

Part II—Field Determination of Damaging Stresses During Driving

Robert D. Chellis
Structural Engineer, Stone & Webster Engineering Corp.

***Contents in Brief**—Factors affecting settlement were outlined in the first article of this series on pile foundations (ENR May 16, vol. p. 774). A major one of them, overdriving, is discussed in detail in this second article. Included are means for determining the stresses developed during driving by simple computations from field measurements of movements under hammer blows.*

THE UNIT FIBER stress at any point in a pile being driven can be determined by using the pile itself as a spring gage to measure its own stress by accepting the validity of Hooke's Law as applied to the pile and the soil. The unit fiber stress in a tapered pile may be larger at some point below ground than at the butt so non-occurrence of damage at the butt is no assurance that damage is not taking place at some point below ground. Hence, a quick method of computation of fiber stress at possible danger points is of value.

NOMENCLATURE USED IN PILE FORMULAS

R_u = Driving resistance (equals ultimate carrying capacity before application of factor of safety only in case of cohesionless soils).
R_f = Driving resistance due to friction above cross-section under construction.
W_r = Weight of ram in pounds.
h = Height of free fall of ram in inches for drop hammers; normal (shortest) stroke of ram in inches for single-acting steam hammers.
E_u = Rated energy of hammer in foot-pounds per blow. (These energy figures for double-acting and differential-acting steam hammers are published by manufacturers for various numbers of strokes per minute.)
e_f = Efficiency. Suggested percentages are: 100 for drop hammers released by trigger; 75-85 for drop hammers actuated by rope and friction winch (may decrease when the drop is small or the drag considerable); 75-85 for Warrington-Vulcan single-acting steam hammers; 85-95 for McKiernan-Terry single-acting steam hammers; 80-90 for British Steel Piling Co. semi-Automatic single-acting steam hammers; 65-75 for Vulcan-California double-acting steam hammers; 85-95 for McKiernan-Terry, Industrial Brownhoist, National and Union double-acting steam hammers; 75-85 for differential-acting steam hammers. (Note—Use the higher values of efficiency when investigating possible stress in a pile. For determining the safe working load on a pile, use of the lower values is recommended, to be reasonably certain of obtaining not less than the assumed energy.)
W_p = Weight of pile in pounds, including shoe, driving cap and follower, if used. In case of driving to end bearing on rock use only one-half the actual total weight.
l = Length of pile in inches, measured from head to center of driving resistance.
s = Set (penetration of pile per blow) in inches.
C_1 = Temporary compression of pile cap, in inches.
C_2 = Temporary compression of pile, in inches.
C_3 = Temporary compression of ground, in inches.
$C = C_1 + C_2 + C_3$.
B = "Bounce" of pile = $C_2 + C_3$.
A_t = Net area of pile at tip, in square inches.
A_p = Net area of pile at any point of stress, in square inches.
E = Modulus of elasticity of pile material.
p = Stress in pile in pounds per square inch at point investigated.

The method is best applicable to a pile having a readily measurable amount of elasticity that is considerable when compared to the elasticity of the pile cap. It is useful in determining stresses in wood, concrete, pipe, H or fluted steel shells, which are subject to damage if over-driven. It is not suggested for light shells driven with heavy mandrels, but this type of pile gives no concern as to fiber stress in driving.

Starting with the basic equation

$$\text{Force} \times \text{distance} = \text{force} \times \text{distance} \quad (1)$$

the weight of the ram of the hammer multiplied by the drop of the ram (in the cases of drop and single-acting steam hammers) would equal the driving resistance of the pile times the penetration per blow

$$W_r h = R_u s \quad (2)$$

were it not for losses in efficiency in the hammer, impact loss, and elastic losses in the pile cap, pile and soil. If this equation is expressed to represent conditions at the top of the driving cap on the head of a pile where it must also take account of the movement at that point, it becomes

$$W_r h = R_u (s + C) \quad (3)$$

in which C represents the total elastic movement of the pile cap, pile and soil. Inclusion of these elastic losses, as well as efficiency losses in the hammer and impact loss, results in the dynamic formula

$$R_u = \frac{e_f W_r h^*}{s + (1/2)(C_1 + C_2 + C_3)} \times \frac{W_r + e^2 W_p}{W_r + W_p} \quad (4)$$

* Use $W_r h$ for drop hammers and single-acting steam hammers. Substitute $12E_u$ for double-acting and differential-acting steam hammers.

[This is the *Hiley* formula for ultimate resistance of soils to driving used by the author in his *Pile-Driving Handbook*—EDITOR]

The terms C_1, C_2 and C_3 represent the total amount of elastic motion at the

top of the pile cap, due to the blow. In the proposed field determination of the stress in the pile at any time it is not necessary to assume or compute these values, since a simple field measurement is sufficient.

In the types of piles under consideration, the elasticity of the pile and soil, $C_2 + C_3$, are large, relative to C_1, therefore it is permissible, and slightly on the safe side, to ignore C_1, the temporary compression in the pile cap, which is small, difficult to measure, and often variable as the condition of the cap packing changes, and measure $C_2 + C_3$ for use in the determination of stress. With wood piles, often there is no cap and C_1 would be zero.

The use of zero for the coefficient of restitution e (which varies from 0.5 for hard surfaces to 0.25 for wood to zero for deteriorated wood surfaces) causes very little change in the results for the types of piles under consideration, which exclude driving with heavy mandrels. For determining fiber stresses in these types of piles during driving the accuracy resulting from inclusion of the coefficient e is not warranted.

The field procedure is to make a graph of the movement of the pile close to the head under several consecutive blows, and from this to measure the rebound as well as the net penetration. The observed rebound is $C_2 + C_3$. If $(\frac{1}{2})\ (C_1 + C_2 + C_3)$ in formula (4) be replaced by the term $B/2$, which is one-half of the observed bounce, representing the average temporary compression, and e let equal zero, then formula (4) becomes

$$R_u = \frac{e_f W_r h}{s + B/2} \times \frac{W_r}{W_r + W_p} \qquad (5)$$

for drop or single-acting hammers, and

$$R_u = \frac{e_f 12E_n}{s + B/2} \times \frac{W_r}{W_r + W_p} \qquad (5a)$$

for double-acting and differential-acting steam hammers.

Fig. 1. This deliberate destruction as part of a demolition job shows the effect unknowing over-driving might have on concrete piles.

For end-bearing piles, the value of the driving resistance R_u is constant throughout the length of the pile, regardless of whether or not the pile is tapered; the value of R_u may be divided by the net area A_t of the tip of the pile to give the maximum unit fiber stress p in the pile, as follows:

$$p = \frac{R_u}{A_t} \qquad (6)$$

For friction piles, or piles resisting the net driving force partly by end-bearing and partly by friction, the point of maximum stress may be at some point above the tip. The fiber stress at any point may be computed by deducting from R_u the proportion of total driving resistance which it is judged has been removed by friction above that point. The amounts of force resisted by the tip, and removed by the different strata, may be quite closely judged by inspection of the boring log and from a foot-by-foot driving record of the number of blows required on the pile. The formula for fiber stress at any point in a friction pile thus becomes

$$p = \frac{R_u - R_f}{A_p} \qquad (7)$$

The above formulas give the amount of the *temporary* resistance to the applied force of driving in cohesive types of soil as well as in noncohesive soils. While the inapplicability of a dynamic driving formula to pile driving in cohesive, or clayey soils can not be too strongly emphasized, as regards determination of *permanent* load-carrying values, in investigating the *stress in the pile during driving* the above formulas are entirely applicable. Since the driving force is generally several times larger than the working load on the pile, it is the stress during driving that requires investigation. The stress in the pile under working load was presumably considered during the selection of the pile, and is within safe working limits.

Measuring pile rebound and set

The most convenient method of measuring the rebound and the set or penetration of a pile under successive blows of a hammer is shown in Fig. 2. The arrangement consists of two stakes driven a few feet each side of the pile, far enough away so as not to be affected appreciably by vibration of the ground surface during driving, with a horizontal cross bar upon which a pencil may be moved from left to right during pile driving. The pencil point rests on a sheet of paper held or tacked to the pile or a board nailed to the pile. The resulting graph will have the form shown in Fig. 2, on which the rebound B corresponding to any value of s can be scaled.

Driving should not stop to permit placing the paper for the graph on the pile, if this is found by trial to result in decreased sets, since this might result in unduly hard driving to loosen the pile, and give results not in line with normal driving. On the other hand, if for some reason it has become neces-

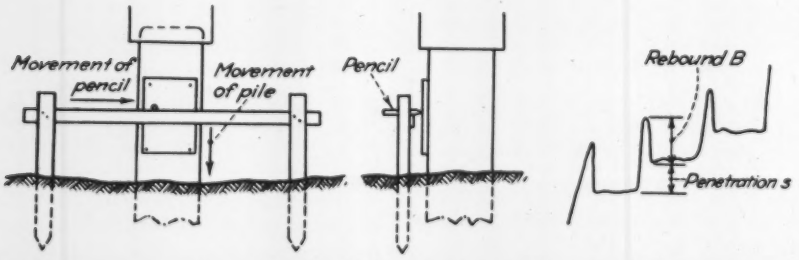


Fig. 2. To measure the penetration (s) and rebound (B) of a pile, a light wood frame is set in the ground and a pencil moved along the horizontal rail to mark the movement on paper attached to the pile.

sary to stop driving before having reached the desired depth, a graph will afford means of checking any unusually high stresses that may occur during the loosening of the piles.

Where driving has been stopped it should be borne in mind that the center of driving resistance is often raised to quite a high point in the pile as redriving starts. This is due to temporary set-up of the ground around the pile, although after the pile has been loosened, driving may become easier and the center of resistance fall to the position that it would have had if no stoppage had occurred. In the case of tapered piles, this affects the area of the pile cross-section to be considered.

It has been observed that the values of s and rebound occurring in piles of various types, such as wood, thin-shelled steel and H-piles, at such time as damage by crushing of wood fibers or heading-over of steel has taken place, have resulted in computed stresses that correspond to the yield points of the materials.

Pile driving formula

Actually, the author uses the above method in the design of the piles and selection of the proper size of hammer, and establishes the safe allowable penetration per blow, before driving has taken place, by means of computations for the values of C_1 and C_2, and an allowance for the value of C_3, verifying the computed values by the field graphs. However, a detailed presentation of these steps is outside the scope of this article but is given fully in

Fig. 3. Break in wood pile from overdriving with a drop hammer.

the author's *Pile-Driving Handbook*.

Briefly, the procedure is to compute the allowable temporary compression in the pile, C_2, from the formula

$$C_2 = \frac{R_u l}{A E} \qquad (8)$$

in which l is taken as the distance in inches from the butt to the center of driving resistance, and A as the average area of the pile cross-section between the butt and center of driving resistance, and to assume C_3 as some value between 0.05 and 0.30, depending upon judgment as to the elasticity of the resisting strata. E is the modulus of elasticity of the pile material. Values of C_1 would be taken from a table or computed in a manner similar to formula (8).

The author has calculated numerous values of permissible sets, s, during driving, by computing values of C_2 and C_3 as described above, and has also checked many of these computations for C_2 and C_3 by measuring the observed rebounds, with close agreement in all cases. In no instances were piles damaged when the stresses computed were less than the yield points of the materials being driven, even though in many cases the computed fiber stress was nearly as large as the yield point value of the material.

In all cases the observed value of s was closely equal to that computed for each particular rebound, and since the computations for s were based on definite values of R_u and corresponding computed values of rebound (Formulas 3 and 4) it follows that the amounts of the forces R_u were verified, and that the stresses obtained by dividing by the pile areas were correct.

Computations verified by tests

An accompanying table shows the results of observations on driving 566 long leaf yellow pine piles having 16-lb. creosote treatment. Piles, 65 ft. long with tips varying from 6 to 11 in. and butts from 13 to 22 in., were driven with a single-acting steam hammer or a heavy drop hammer. Minimum sets for each tip size was specified from the theoretical set-bearing value graphs prepared, as described above, prior to driving.

A number of field graphs were taken that verified the accuracy of the terms C_2 plus C_3, or B assumed in preparing the set-bearing value graph, so that such a curve could have been prepared merely from rebound observations and given the same resistances and stresses as computed before driving.

It will be noted that the small percentage of breakage was reasonably constant, rising quickly when the assumed limiting value of 2,600 psi. driving stress was closely approached or exceeded. The trend is definite, although not all overdriven piles broke, nor did the direct fibre stress in the piles that broke always exceed the limit proposed. These individual deviations, and occasional breakages in the larger piles are attributable to defects in the piles, such as curvature, knots, seasoning damage, eccentric driving and the variations in natural strength of the different piles.

Part III of this series "Making and Interpreting Pile Load Tests" will appear in an early issue.

RELATION OF PILE BREAKAGE TO FIBER STRESS DURING DRIVING

Creosoted pine piles 65 ft. long driven 15 ft. into sand

Tip dia. of piles	6	6½	7	7½	8	8½	9	9½	10	11
Driven with No. 1 Vulcan hammer										
Specified minimum set, in.	.50	.....	.33	.20	.10		Unlimited			
Average set	.54	.53	.42	.30	.25	.27	.25	.15	.19	.19
*Fiber stress, psi.										
Average	2,900	2,500	2,550	2,600	2,400	2,200	2,000	1,950	1,700	1,600
Minimum	2,600	2,300	1,650	1,500	1,900	1,450	1,250	.....	.....	.....
Maximum	3,000	2,650	3,350	2,900	2,650	2,400	2,200	.....	.....	.....
Piles driven	3	4	101	64	130	38	48	9	17	5
Piles broken	0	0	9	6	8	2	2	0	1	0
Driven with 3,450 lb. drop hammer, 5 ft. fall										
Specified minimum set, in.	.67	.....	.33	.22	.14		Unlimited			
Average set	.....	.....	.46	.39	.29	.30	.30	.25	.20	.....
*Fiber stress, psi.										
Average	.....	.....	2,800	2,350	2,350	2,100	1,900	1,800	1,750	.....
Minimum	.....	.....	2,350	1,150	1,200	1,700	1,000	.....	.....	.....
Maximum	.....	.....	3,000	2,700	3,050	2,450	2,200	.....	.....	.....
Piles driven	.....	.....	21	27	44	25	25	6	6	.....
Piles broken	.....	.....	2	1	1	0	0	0	0	.....

*Fibre stress at center of driving resistance, in pounds per square inch.

Calculation of Bearing Capacities Of Footings by Circular Arcs

Paul Andersen
Professor of Structural Engineering,
University of Minnesota, Minneapolis, Minn.

***Contents in Brief**—For computing shearing resistance of soil supporting footings whose lengths are large compared to their widths, it is assumed that the surface of rupture can be approximated by circular arcs. Rational formulas are then developed, taking into account effects of soil characteristics, such as weight, angle of friction and cohesion. These formulas give results consistent with test data relative to depth of support and shape and size of footing. Comparisons are also made with other methods for determining bearing capacity from frictional and cohesive properties, especially the Krey graphical method.*

WHILE SETTLEMENTS under a footing are caused by consolidation of the supporting soil, actual rupture of the ground is due to a shear failure along some curved surface. Usually this surface extends under and from one edge of the footing, intersecting the ground surface at an angle depending on internal friction but about 45 deg. When the shape and area of this surface are known, the capacity of the footing may be gaged by several methods, the most widely known of which is the graphical procedure of Krey. A method similar to Krey's but using circular arcs to approximate the surface of rupture, as described in this article, simplifies computations.

The Krey method (Fig. 1), applying to footings whose lengths are large compared to their widths, assumes that the surface of failure consists of a cylindrical surface passing through one edge of the bearing area plus a tangent plane making an angle of $45 - \phi/2$ deg. with the horizontal, where ϕ is the angle of internal friction. The surface offering the least resistance to rupture is determined by a process of trial and error.

Thus, for the circle with C_1 as center and its corresponding tangent BC, the three forces E_1, W and K_1 denote, respectively: passive earth pressure on BD (including cohesion, if any), weight of soil bounded by arc AB and line BD, and cohesion along arc AB. The resultant R of these forces is then combined with the unknown bearing pressure P so as to produce a final resultant that is tangent to the circle of friction having a radius of $r \sin \phi$. The force P determined in this manner is plotted vertically above the center C_1 of the two circles, and the process is repeated for a number of other surfaces corresponding to C_2, C_3, etc. The smallest value of bearing pressure P is the maximum that the footing can transmit without failure occurring in the supporting soil.

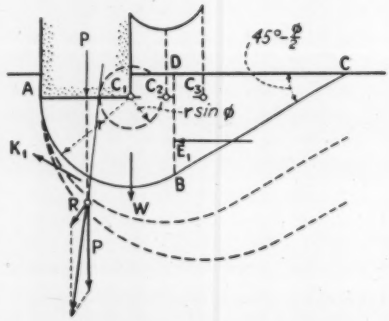


Fig. 1. Krey's method of determining bearing capacity assumes a surface of rupture consisting of a cylindrical surface AB and a tangent plane BC.

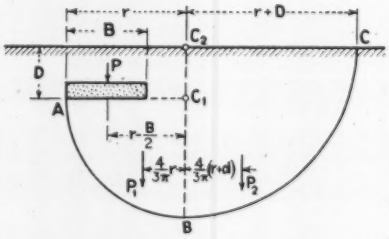


Fig. 2. Two 90-deg. arcs, assumed as surface of rupture, simplify calculation of bearing capacity.

Simplified method uses two arcs

The width B of footing to sustain a load P may be determined more easily if it is assumed that the surface of failure can be approximated by two 90-deg. arcs AB and BC (Fig. 2) and that movement is prevented by shearing stresses acting in the clockwise direction. Following is an analysis for the case of cohesionless soil.

The shearing resistance of a small element of the failure line (Fig. 3) is $N \tan \phi$, N being the normal pressure intensity. If only the unit weight w of the overlying soil is considered, it is seen from Fig. 3 that the total vertical force acting on an infinitesimal element will be $wr^2 \sin^2 \theta d\theta$, and the normal component on this element will be $wr^2 \sin^3 \theta d\theta$.

The footing load P will further increase the shearing resistance on portions of the surface of rupture immediately below the footing. In computing its effect, cognizance is taken of investigations ("Shear Failures under Footings," by Paul Andersen, *Civil Engineering*, Vol. 14, No. 8 (1944), p. 360), which indicate that radius r of arc AB is only slightly greater than the footing width. It will therefore be assumed that P is uniformly distributed over arc AB.

In the case of a concentrated load P, assumed uniformly distributed over width r, the normal component on an infinitesimal element will be $Pd\theta \sin^2\theta$.

If moments are taken about the cen-

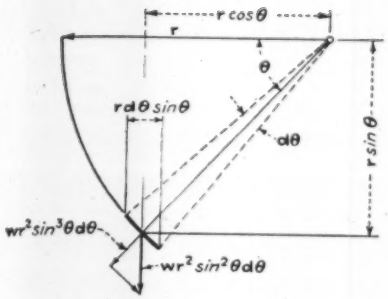


Fig. 3. Forces acting on small element of rupture surface evaluated, assuming cohesionless soil.

ter of arc AB (except that shearing stresses along arc BC are referred to its center), the following equation will result:

$$P\left(r-\frac{B}{2}\right)=\int_0^{\pi/2} wr^3\sin^2\theta\tan\phi d\theta + \int_0^{\pi/2} P\sin^2\theta\tan\phi r d\theta + \int_0^{\pi/2} w(r+D)^3 \sin^2\theta\tan\phi d\theta + \frac{w}{3}[(r+D)^3-r^3]$$

in which D is the depth of bottom of footing below the ground surface. The last term represents the difference between the moments of forces P_1 and P_2 (earth weights involved in movement). Completing the integrations and solving for B gives

$$B=r\left(2-\frac{\pi}{2}\tan\phi\right)-\frac{2w}{3P}[r^3(2\tan\phi-1)+(r+D)^3(2\tan\phi+1)]$$

To each value of r will correspond a value of footing width B over which the foundation pressure P must be distributed in order to avoid failure along the corresponding circular arcs. The most dangerous failure line is the one which gives the largest value of B. If B is large enough to prevent failure along this line, it will automatically satisfy all other failure lines. Placing the first derivative of B with respect to r equal to zero gives

$$r^2-\frac{2\tan\phi+1}{2\tan\phi}Dr+\frac{2\tan\phi+1}{4\tan\phi}D^2+\frac{P}{W}\cdot\frac{\frac{\pi}{2}\tan\phi-2}{8\tan\phi}=0$$

The last two equations can be used to determine for a cohesionless soil the footing width needed to sustain a given load at a given depth when weight of soil and angle of internal friction are known.

Cohesive Soil

In the case of a cohesive soil, the shearing resistance along ABC will be increased by cohesive forces k. It is readily verified that the total moment with respect to the center of the cohesive forces acting tangentially to a 90-deg. arc is

$$\int_0^{\pi/2} krd\theta r=\frac{\pi}{2}kr^2$$

If this expression is added to the right side of the equation previously obtained for B, for cohesive soil B can be determined from

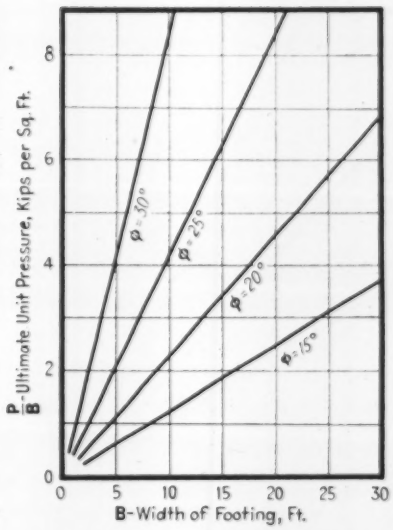


Fig. 4. For footings resting on surface of cohesionless soil and for a given angle of internal friction, ultimate unit pressure bears a straight-line relationship to the width of footing.

$$B=r\left(2-\frac{\pi}{2}\tan\phi\right)-\frac{2w}{3P}[r^3(2\tan\phi-1)+(r+D)^3(2\tan\phi+1)]-\pi\frac{k}{P}[r^2+(r+D)^2]$$

while r is found from

$$2r^2\tan\phi+(2\tan\phi+1)Dr+\frac{k}{w}\cdot\pi r+\frac{1}{2}(2\tan\phi+1)D^2-\frac{k}{w}\cdot\frac{\pi}{2}D-\frac{P}{4w}\left(2-\frac{\pi}{2}\tan\phi\right)=0$$

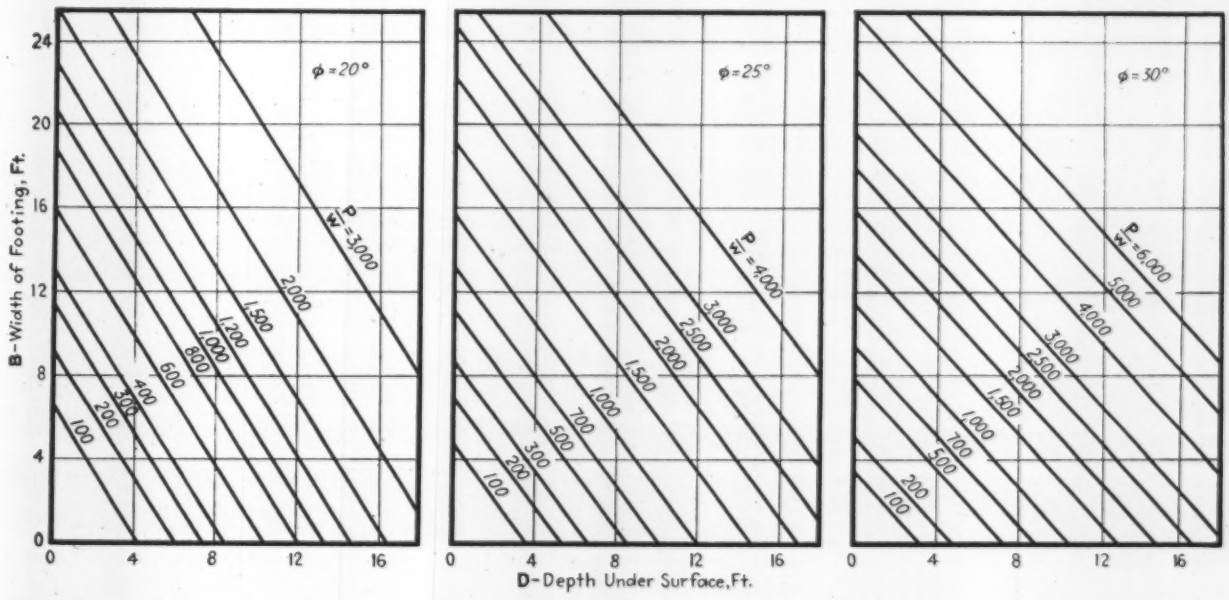


Fig. 5. Design diagrams for cohesionless soil show the effect upon bearing capacity of depth below surface, for various angles of internal friction and ratios of load to soil unit weight.

The formulas developed for pressure intensities give ultimate values at which rupture will occur. If they are applied to design of footings, suitable factors of safety should be used.

Example 1. It is desired to find the footing width for a load $P = 50{,}000$ lb. resting on top of a cohesive soil possessing the following characteristics: $k = 2{,}000$ psf., $\phi = 9$ deg., $w = 100$ lb. per cu. ft.

If these quantities together with $D = 0$ are substituted in the last two equations, it is found that $r = 3.42$ ft. and $B = 3.05$ ft. The load intensity before rupture of soil will then be $50{,}000/3.05 = 16{,}393$ psf.

Example 2. The soil characteristics are the same as in the preceding example. Find the footing width for $P = 200{,}000$ lb. Substituting in the same equations, it is found that $r = 13.07$ ft. and B = 12.16 ft. The load intensity for the larger load is, therefore, $200{,}000/12.16 = 16{,}452$ psf.

It is seen from these examples that the method gives, for soils of high cohesive strength, slightly higher load intensities for larger footings. The higher bearing capacities for larger footings become more pronounced for soils of small cohesive strength. If, in the preceding examples, the cohesive strength is reduced from 2,000 to 200, the bearing capacities will be $50{,}000/27.68 = 1{,}806$ psf. and $200{,}000/64.4 = 3{,}105$ psf., respectively. The latter represents an increase of 72 percent over the former. For cohesionless soils this increase becomes still higher. The method described in this article gives for frictional soils a straight-line relationship between width of footing and pressure intensity as shown in Fig. 4, which has been plotted for a unit soil weight of 100 lb. per cu. ft. and a footing resting on the surface of the ground.

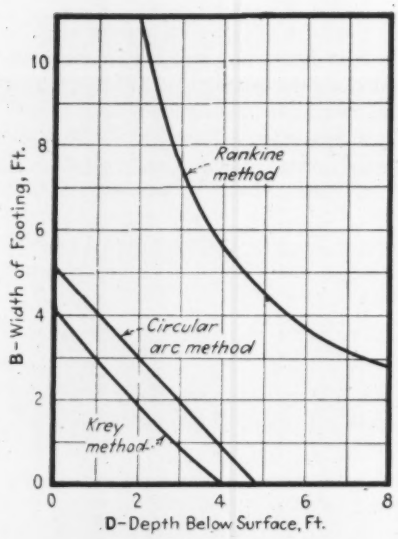


Fig. 6. In comparing three methods for determining capacity of cohesionless soil, a load of 20 kips, a 30-deg. angle of internal friction and a soil unit weight of 100 lb. per cu. ft. have been assumed.

The effect upon bearing capacity of depth below surface is shown in Fig. 5, where width of footing is plotted against depth for various angles of internal friction and ratios of load to soil weight. These relationships are straight lines. They can be used for design of footings, and interpolation can be effected for intermediary values.

A comparison between the method of circular arcs and two other methods is shown in Fig. 6, in which a load of 20 kips and a cohesionless soil ($\phi = 30$ deg.) have been assumed. The so-called Rankine formula

$$BD = \frac{P}{w}\left(\frac{1 - \sin\phi}{1 + \sin\phi}\right)^2$$

can be expressed as a hyperbola giving zero bearing capacity for a footing resting on the surface and a bearing surface that can be reduced to a point when the depth is infinite. Points on the slightly curved line representing the Krey method were arrived at by performing the graphical construction illustrated in Fig. 1. The analytical method of circular arcs yields a straight line slightly above the Krey method.

Evaluating bearing capacities of footings for safety against failure by shear along circular arcs gives results that show reasonable agreement with Krey's graphical solution. It has also been shown that the bearing pressure increases with depth of footing below the top surface and is directly proportional to the width of the footing on a purely frictional soil. On a cohesive soil there is also an increase in bearing capacity for the larger footings but not as pronounced as for cohesionless soils.

DDT Hailed as Best Insect Weapon

DDT—the Army's highly-praised insecticide—may be the most effective weapon yet devised for combatting some of the most deadly and debilitating diseases to which human beings fall heir, in the opinion of Dr. F. C. Bishopp, assistant chief of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

However, he cautioned that it is not capable of measuring up to all of the claims made by enthusiastic writers and the ideas read into these stories by an imaginative public. Dr. Bishopp's remarks were made at a meeting of the American Society of Civil Engineers in New York City.

While it is too early to be positive about results, said Dr. Bishopp, it seems safe to say that malaria is "on its way out" and that within a few years it will be as rare in our southern states as it has become in Ohio and Indiana.

DDT is generally regarded as the most useful single weapon at hand for killing mosquitoes, which are the sole carriers of malaria. By means of aerial spraying of swamps and jungles, using 2 quarts of powder to one gallon of a 5 percent oil solution, virtually all the mosquitoes are wiped out.

Not only is it an effective weapon against mosquito, fly and fly-borne diseases, and tick-transmitted and louse-carried diseases, but of perhaps greater importance is its value in eliminating many disgusting and annoying pests that attack man and infest his home.

Having DDT in proper form is not enough—it must be properly diluted and properly applied at the right time in the right amounts and in the right places.

While DDT is an insecticide, and most insecticides are poisonous to higher animals including man, DDT is less poisonous than a number of materials commonly used in the war on insects. In large doses, either taken by mouth or absorbed through the skin in oil solutions, it causes serious ill effects or even death.

In powder form, however, DDT is not absorbed, nor does it produce skin irritation or appreciable sensitization. In no form should it be allowed to get into foods. The solvents are more likely to produce illness, such as headache and nausea, than the DDT itself.

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

Terra Cotta Tile Saw

Two small motors, four roller skate wheels and a carborundum disk form the principal parts of a home-made saw used for cutting the interior terra cotta tile trim at Chicago's South District filtration plant. Developed and constructed by Einar Johnson of Chicago, shown operating the saw, it was used on the million-dollar contract held by S. N. Nielson Co., Chicago, for construction of the chemical building and low-lift pump house.

The saw is simple in operation and has few moving parts. A $\frac{1}{8}$-in. thick, 12-in. dia. carborundum stone disk does the cutting, powered by a 2-hp. electric motor. A $\frac{1}{2}$-hp. motor operates a small fan which blows all terra cotta dust into a canvas bag attached to the machine.

The fan is protected from possible damage caused by flying pieces of terra cotta by a small screen placed in the suction tube leading from the cutting stone to the fan.

A 28x36-in. working table forms the top of the cutting machine. It is made of 2-in. lumber, slotted to receive the carborundum cutter and hinged at the rear to permit easy access to the operating equipment. The cutting mechanism can be lowered or raised by a hand screw to regulate the depth of cut and to compensate for the wear on the cutter. A slotted, thin steel plate slides back and forth on top of the work table when cutting a tile. This plate operates on four steel rollers salvaged from ordinary roller skates and carries a T-shaped timber guide to insure tile being cut square.

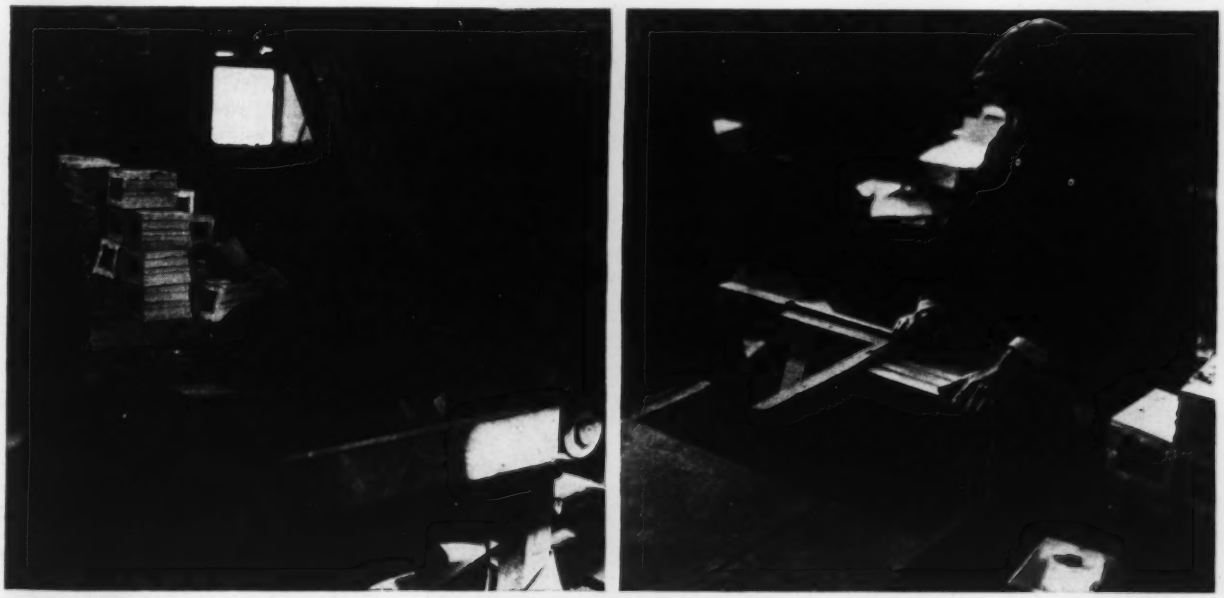
Hydrant Over Main Saves Space

A problem that often confronts engineers engaged in public work is the lack of adequate space for such underground structures as storm sewers, sanitary sewers, water mains and gas lines. This is especially true in the metropolitan areas where subdivisions of acreage have been made without adequate zoning provisions or planning of utilities.

With the thought of conserving such space as is available, the Lucas County Sanitary Engineering Department, Toledo, Ohio, has adopted a new hydrant assembly that places the standpipe directly over the water main. This procedure eliminates the conventional hydrant offset, which usually requires from 3 to 4 ft. of space and which, in many cases, has to be moved at a later date to provide for other underground utilities.

The new assembly consists of a special Y casting placed in the water main with the Y branch in a vertical position. Both valve and hydrant are connected to this vertical leg, thus placing them directly over the main as shown in the accompanying photograph. The space between the main and the valve and hydrant is then filled with a lean concrete to absorb any shock resulting from vehicle collision or other impact on the hydrant standpipe. Lean concrete is used so that it can be readily removed in the event that the hydrant has to be relocated at some future date.

It is claimed that the installation is simple to assemble and that it speeds up construction operations, especially where a trenching machine is used, as it eliminates the hand excavation necessary for the conventional tee and hydrant offset. Contractors installing the new-type connection assemble the



Terra cotta tile is cut by a home-made saw containing a motor-driven carborundum stone cutter (left) and a sliding work table (right) operating on four steel rollers salvaged from ordinary roller skates.

Special Y-branch fitting allows hydrant and valve to be set over water main, saving space through elimination of hydrant tee and offset.

hydrant and valve on the surface and then place it in position over the line immediately following installation of the Y branch and the following pipe section.

The new assembly is being used exclusively where hydrants are called for in the county's present service expansion program, which involves about 25 mi. of 6-in. and 8-in. water main extension.

Spacing Girder Stiffeners

The American Institute of Steel Construction *Specification for the Design, Fabrication and Erection of Structural Steel for Buildings*, adopted in 1936, requires stiffeners for plate girders whenever

$$\frac{h}{t} > \frac{8{,}000}{\sqrt{v}},$$

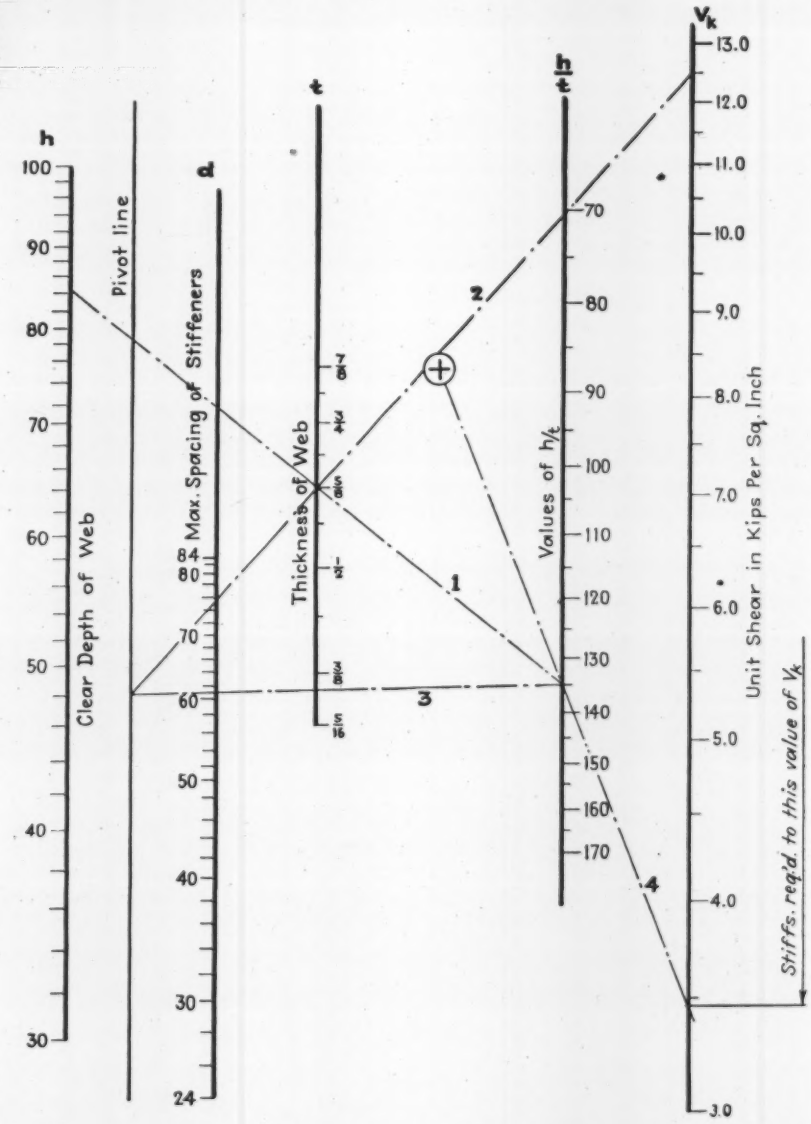
where h is clear depth in inches between flanges, t web thickness in inches and v shear in web in psi. Stiffener spacing d must not exceed 84 in., and

$$d < \frac{270{,}000\alpha}{v}\sqrt[3]{\frac{Vt}{h}}$$

The accompanying nomograph may be used to determine if stiffeners are required and the maximum spacing when they are needed. The value of h/t is first found either by slide rule or from the nomograph by extending a line through h and t (line 1) to its intersection with the h/t - scale. If this point is then connected with the center of the circled cross (line 4), the intersection with the v_k - scale is the shear in kips per sq. in. above which stiffeners are required.

To determine the spacing, mark the point on the pivot scale where a line through v_k and t (line 2) meets it, connect this point with h/t (line 3), and at the intersection with the d - scale, read the maximum permissible spacing. When the specification of the American Association of State Highway Officials is used, 91 percent of the chart reading is the limiting distance between stiffeners.

As an example, consider a plate girder with a $\frac{5}{8}$-in. thick and $84\frac{1}{2}$-in. depth of web and shear of 12.5 kips per sq. in. Line 1 indicates that h/t is 135. Since line 4 calls for a maximum shear of 3.4 kips per sq. in., stiffeners are necessary. Line 2, joining the shear of 12.5 and web thickness of $\frac{5}{8}$, locates the point on the pivot line that, when joined with $h/t = 135$ (line 3), sets the maximum spacing on the d-scale at 61 in.—B. L. PARKER, *Structural Engineer, Arthur G. McKee & Co., Cleveland, Ohio.*



Nomograph determines if stiffeners are required and the maximum permissible spacing according to the 1936 AISC specifications.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Deeper Pneumatic Piers

Sir: *ENR*, May 2, 1946, vol. p. 737, carried a letter from R. B. Alsop, Westfield, N. J., relative to the depth attained in pneumatic pier construction of the Carlton Bridge across the Kennebec River at Bath, Maine.

In his letter Mr. Alsop stated depth of Pier No. 2 of that bridge was 123.7 ft. below *high water*. The piers of the new Santa Fe Railway Bridge across the Colorado River at Topock, Arizona, the substructure of which was built by the Kansas City Bridge Co., are twin cylinders all carried to a minimum of 2 ft. into rock below the cutting edge.

Pier No. 3-N was sealed at a depth of 125.34 ft. below *actual river level*. This, to our knowledge, is the deepest pneumatic pier constructed.

O. W. ANSCHUETZ,
Chief Engineer
Kansas City Bridge Co.

Suspension Bridge Stiffening

Sir: In his interesting article (*ENR* March 7, 1946 vol. p. 347) on the cable-stiffened suspension bridge, William G. Grove states "In conventional suspension bridges, the stiffening trusses are very uneconomic members, since they carry no dead load, only about 20 percent of the live load, and yet account for about 50 percent of the weight of the steelwork". Without proper qualification this statment conveys an entirely erroneous impression of waste involved in stiffening trusses in suspension bridges and of the economic possibilities of substituting other stiffening systems, such as that described by Mr. Grove.

The 50 percent ratio of truss weight to steel weight, which presumably does not include the towers, can apply only to very short spans carrying relatively heavy live load concentrations. In properly designed modern suspension bridges of medium and long spans the corresponding ratio is only a fraction of that figure.

A proper economic picture must be based, however, on comparative cost and not merely on suspended steel weight. On that basis it will be found that in a properly designed highway suspension bridge the cost involved in providing stiffening trusses is a very small percentage of the total cost, and the substitution of any other adequately designed stiffening system for stiffening trusses can influence the economy of the design only to a minor extent. The benefit of any saving may be more than offset by increased cost of maintenance, not to speak of the relative value of appearance.

Other design factors reflecting the personal judgment of the designer, such as assumed loads, unit stresses, etc., are apt to influence the economy of any design to a much more marked degree. For temporary military purposes, for which the study of the system described by Mr. Grove evidently was intended, and for which quick erection with readily obtainable parts may be of importance, cost of maintenance and durability of little account and appearance insignificant, such a system may have its justification. But for a permanent structure the merits of the system are doubtful.

O. H. AMMANN
Consulting Engineer
New York, N. Y.

Sir: In my article, I should have made the statement that the stiffening trusses on the designs actually made at the Engineer Board weigh about 50 percent of the steelwork "exclusive of the main towers".

The actual figures prepared by the bridge design department at the Engineer Board gave as stiffening truss weights 566,000 lb. 303,000 lb. and 80,000 lb. for the 600 ft., 400 ft. and 160 ft. spans respectively; also the total weights of steel, exclusive of the two towers, were given as 1,063,000 lb., 581,000 lb. and 172,000 lb. respectively; thus the ratios are 53, 52 and 47 percent for the three lengths of spans, an average of 51 percent.

Of course, the designs are for military bridges, with wooden decks and carrying heavy tanks, so that the weights of the vehicles were relatively higher with respect to the dead load of the suspended portion of the bridge than would be the case in commercial bridges using solid concrete decks.

The whole theory of the cable-stiffened type is based on the fact that sufficient rigidity can be obtained by the use of prestressed hold-down cables and a series of prestressed double diagonal ropes in each panel of the cable system, without structural steel stiffening trusses, and the tests made thus far on the Roebling model have substantiated that theory.

WILLIAM G. GROVE
Engineer of Bridges and Structures
State Highway Department
Hartford, Conn.

Education in construction

Sir: Upon my recent return to the University of Colorado from construction work on the Ledo Road, I had about the same ideas as expressed (*ENR* April 4, vol. p. 500) by Commander Kravath. I should like to distinguish between fundamentals and details of construction and then agree wholeheartedly on the necessity of teaching fundamentals of construction in a civil engineering curriculum. Most important are the capabilities of the machines in each category, and the type of work each available attachment is best suited for.

Thus arises the problem of how to teach all of this necessary subject matter in a short period of time. Our four-year civil engineering curriculum is already so full of apparently necessary courses that considerable thought is being given to a five-year course. The best apparent solution now is to modify some existing courses to include study of construction equipment and methods. This is a difficult subject to put over. An important aid, one which we are relying on, is visual education, either movies, slides or film strips. Procurement of good construction films at low cost is a problem not solved at this time.

Another item to help the student is a collection of catalogs, handbooks, and other literature put out by the manufacturers of construction equipment. Much can be learned from a study of the pictures and data given in these books.

Any course so taught will give the

students a general coverage of construction terms and practices. Experience can be obtained only on-the-job, not in the classroom.

LEO C. NOVAK
Lt. Col., Corps of Engineers (Reserve)
Assistant Professor of Civil Engineering
University of Colorado

Prestressed Water Tank

Sir: The problems associated with prestressing concrete described in the article, "Two-way Prestressed Concrete Water Storage Tank," (*ENR* Oct. 4, 1945, vol. p. 108) were well presented and apparently adequately solved. However, it is the writer's opinion that the true interaction between steel and concrete in a rigid prestressed member or structure is seldom appreciated and even those who advocate prestress are sometimes none too clear about it.

Fig. 1. Vertical section through two-way prestressed concrete wall of tank in Montana indicates irregularity of shape.

Analysis of the vertical reinforcing in the Montana tank will bring out an interesting complication due to non-uniformity of concrete section throughout the length of prestressed bars. In the wall section (Fig. 1), the selected prestress of 32,000 psi. on 43/64-in. rods 12 in. c. to c. requires a force of 11,400 lb. on each rod and each foot of wall. Rod length is 34 ft. and elongation will be PL/AE or 450 $\times 10^{-3}$ in. By the same formula, the concrete yield under the nut will be the sum of the yield in the uniform section of parapet plus that in the tapered wall section (using the average cross section thereof).

Thus, by calculation, $\Delta c = 11{,}400\ (48/144 + 360/82) \div 2.9 \times 10^{-6} = 18.5 \times 10^{-3}$ in. Total movement of the strain nut on each steel rod will be 468.5×10^{-3} in. Therefore, if correct allowance is not made for yield of concrete under the nut washer the actual steel prestress will be in error 4 percent. When percentages of prestressed steel in concrete is increased from 0.5 percent, as in this case, to say 3 percent, the error in prestress will be as much as 25 percent.

A helpful but simple graphical illustration (Fig. 2) of the prestress picture for any reinforced member can be made as follows: If OC is length of member to be prestressed, OA stress-strain curve for steel reinforcing over OC in tension and OB stress-strain curve for concrete under the same loads over OC, any desired prestress in either steel on concrete can be selected on verticals MB or NA. A horizontal line at that value, as at D or E, will intersect both stress-strain curves in points that determine the stressed lengths of steel and concrete. For example, when the nut on the rod (hence, end of concrete) is brought to K_1 or K_2, the end of the steel rod will be at L_1 or L_2 respectively. Scaled dimension of rod protrudance as K_1L_1 or K_2L_2, when obtained on the job, will assure correct prestress.

A few comments on this job are offered. (a) It appears possible and desirable that the prestressed vertical wall steel could have been extended into the base slab by means of threaded stubs, and then the construction joint at the base of the slab would have benefited by the prestress compression. (b) Apparently, the horizontal rod turnbuckles, at many points, project several inches outward into the 4-in. thick outer wall section and interfere with the straight run of vertical steel one inch away. (c) What effect will a solid sheet of ice, say 12 in. thick (possible in Montana), have on the side wall thrust? (d) Since prestressed members deform the same amount under load as they would if not prestressed (a fact seldom appreciated), the outer wall will experience just as severe stresses on filling the tank or from temperature shrinkage as if the horizontal or vertical steel had not been prestressed. (e) A full scale sketch of the circumferential $1\frac{3}{8}$-in. round rods placed against the outer surface of the inner wall shows a difficult, if not unwise concrete placing situation (Fig. 3). It is doubtful if much good concrete will be found between the inner wall and the underside of the round rods.

None of the above remarks are intended to imply that those responsible for the engineering planning and supervision of this job did not take proper cognizance of the details discussed. This letter is only for the purpose of "prestressing" a few important and not obvious considerations in good prestress design.

R. D. KARR
Chief, Technical Section,
Maintenance and Repair Div.
War Shipping Administration
San Francisco 4, Calif.

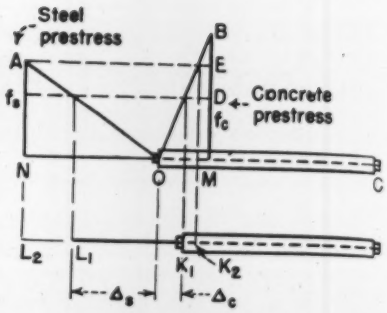


Fig. 2. Effect of prestressing determined by a graphical construction in which deformations are plotted horizontally, stresses vertically.

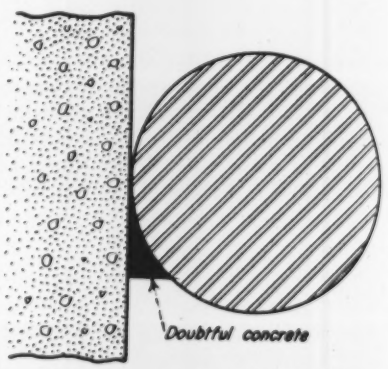
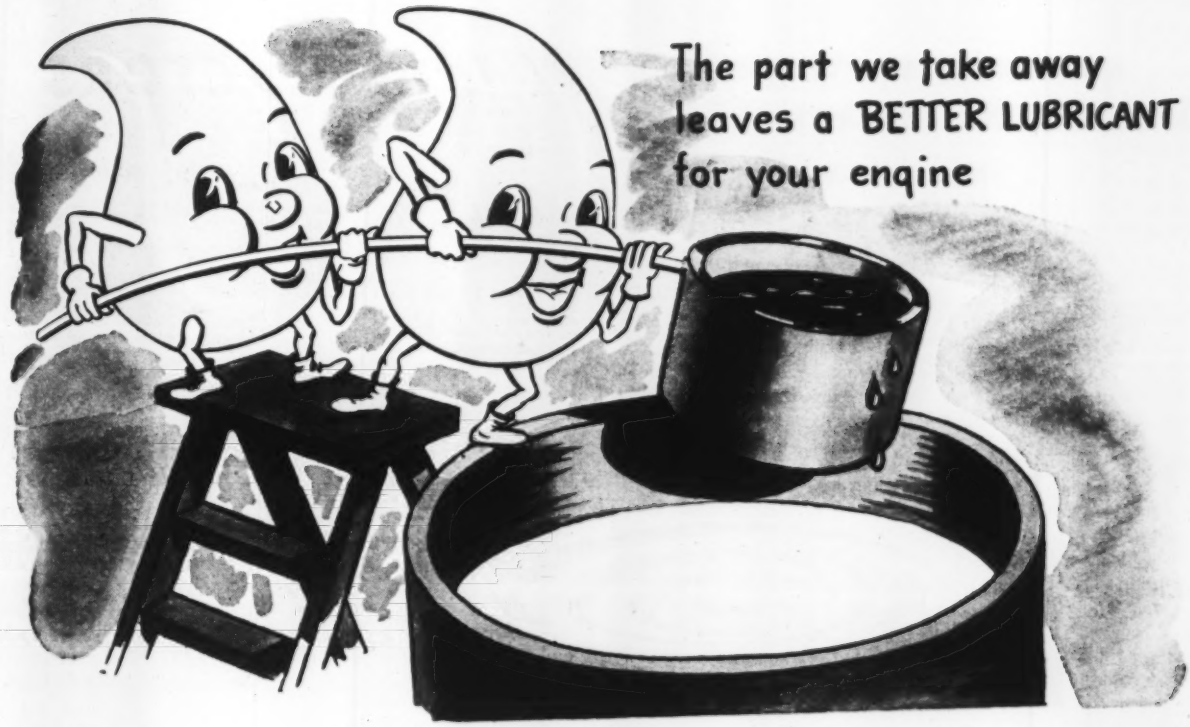


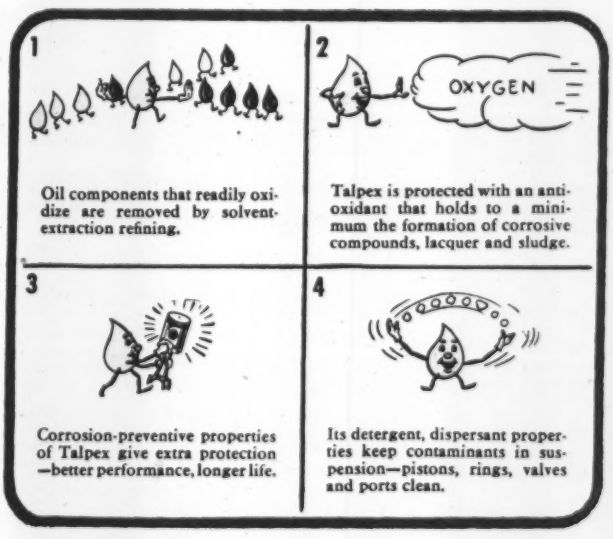
Fig. 3. Prestressed bar placed directly against hardened concrete makes placing of fresh concrete difficult.

Danish Bridge Span Lengths

In the article, "Denmark in the World of Engineering", which appeared in *Engineering News-Record*. March 21, 1946, vol. p. 413, the caption under the picture of the Queen Alexandrine Bridge states that "the central span is a 2,440-ft. steel arch, and it is joined at either end by five reinforced concrete spans." The 2,440 ft. is actually the length of the entire eleven spans. The steel arch has a span of 390 ft., while the concrete arches vary from a maximum of 200 ft. down to 148 ft.—EDITOR



THESE FOUR *TALPEX* PERFORMANCE FACTORS SAFEGUARD HIGH-SPEED DIESELS


1
Oil components that readily oxidize are removed by solvent-extraction refining.
2
OXYGEN
Talpex is protected with an anti-oxidant that holds to a minimum the formation of corrosive compounds, lacquer and sludge.
3
Corrosion-preventive properties of Talpex give extra protection —better performance, longer life.
4
Its detergent, dispersant properties keep contaminants in suspension—pistons, rings, valves and ports clean.

THAT'S perfectly good engine oil being removed from lube oil "stock" that is destined to become Shell Talpex. Perfectly good, that is, except for its bad habit of quickly "mating" with oxygen. Such oxidation would result in the formation of corrosive compounds, sludge and lacquer—all bad for your engine.

Shell uses a special solvent-extraction process to take away these readily oxidized compounds. Next, the refined Talpex is further protected with an anti-oxidant, and is given corrosion-preventive and detergent properties.

If the oil you are now using doesn't have these four performance factors, your Diesels aren't getting the benefit of all that's new in lubrication—and you had better change to Talpex!

The Shell Lubrication Engineer will give you sound advice about the lubrication of *any* type of Diesel, whether slow, medium, or high speed. Write for a copy of Shell's booklet, "The Fundamentals of Diesel Lubrication." Shell Oil Company, Incorporated, 50 West 50th St., New York 20, N. Y., or 100 Bush St., San Francisco 6, California.

SHELL

SHELL DIESEL LUBRICANTS

UNIT PRICES BID BY CONTRACTORS

Railroad for Garrison Dam, North Dakota

OWNER: U. S. Engineers, Omaha District Lt. Col. D. B. Freeman, District Engineer, Omaha, Nebr.

PROJECT: Access Railroad including all grading, drainage, track, to Garrison Dam site, North Dakota, 10 miles of track, 171,000 cu.yd. excavation. This contract carries railroad only to townsite of Riverdale on bluff east of dam. Future contract will extend route down side of valley to construction bridge site.

CONDITIONS: Owner will furnish rail, tie plates, joint bars, track bolt, contractor to furnish other materials. Rail transportation at one end of job, highway at one end. Grading fairly light. Good ballast scarce in vicinity. Minimum wage rates specified: ironworkers, structural, $1.50; reinforcing, $1.44; carpenters, $1.25; operators: compressor, $1.00; cranes and shovels and draglines, $1.50; hoists, $1.40; motor graders, $1.40; pavers, $1.40; mixers, $1.00; pile drivermen, $1.25; rollers (to 8 tons), $1.20; (over 8 tons), $1.40; tractors, $1.30; trucks, 80c.; common labor, 70c.

BIDS: Six bids were received April 2, 1946, ranging from the contract low $398,215.45 to $703,181.78, compared with the government estimate, $447,402.21.

LIST OF BIDDERS:

1. Wm. A. Smith Constr. Co., Houston, Tex. (contract) $398,215.45
2. Northwestern Engr. Co., Rapid City, S. Dak. 474,426.35
3. S. J. Groves & Sons Co., Minneapolis, Minn. 476,875.30
4. Peter Kiewit Sons Co., Omaha, Nebr. & Morrison-Knudsen Co., Seattle, Wash. 479,664.78
5. Okes Construction Co., St. Paul, Minn. 551,729.05
6. Kramme & Jensen Constr. Co., Des Moines, Iowa 703,181.78

Item	Quantity	Unit Prices (1)	(2)	(3)
1. Unclassified Excavation	171,200 cu. yd.	$ .25	$ .225	$ .22
2. Water for Embankment Compaction	5,025 1000 gal.	.55	.50	.50
3. Rolling for Additional Compaction	200 roller hr.	4.40	4.00	4.00
4. Structural Excavation	1,500 cu. yd.	1.10	1.00	1.00
5. Main Track and Ballast	50,694 lin. ft.	4.35	5.55	5.85
6. Side Track and Ballast	7,714 lin. ft.	3.55	5.55	5.15
7. Turnouts, No. 7	8 each	1,200.00	1,500.00	1,450.00
8. Turnouts, No. 9	4 each	1,250.00	1,650.00	1,620.00
9. Switch Stands, Intermediate Type	4 each	50.00	300.00	60.00
10. Switch Stands, Low Type	4 each	40.00	300.00	30.00
11. Derailers	4 each	25.00	50.00	30.00
12. Bumping Posts	2 each	200.00	50.00	130.00
13. Furnishing and Installing 15-inch Circular Corrugated Metal Pipe	398 lin. ft.	2.00	1.86	2.00
14. Furnishing and Installing 18-inch Circular Corrugated Metal Pipe	136 lin. ft.	2.75	2.50	2.25
15. Furnishing and Installing 24-inch Circular Corrugated Metal Pipe	154 lin. ft.	3.50	3.13	3.25
16. Furnishing and Installing 30-inch Circular Corrugated Metal Pipe	60 lin. ft.	4.25	3.78	4.50
17. Furnishing and Installing 36-inch Circular Corr. Met. Pipe (14 gauge)	222 lin. ft.	5.00	4.52	5.00
18. Furnishing and Installing 36-inch Circular Corr. Met. Pipe (10 gauge)	130 lin. ft.	7.50	6.89	7.50
19. Furnishing and Installing 42-inch Circular Corrugated Metal Pipe	102 lin. ft.	7.75	6.96	7.00
20. Furnishing and Installing 48-inch Circular Corrugated Metal Pipe	128 lin. ft.	10.25	9.33	9.50
21. Furnishing and Installing 18-inch by 11-inch Corrugated Metal Pipe Arch	24 lin. ft.	2.40	2.08	2.25
22. Furnishing and Installing 29-inch by 18-inch Corrugated Metal Pipe Arch	100 lin. ft.	4.00	3.57	4.00
23. Furnishing and Installing 36-inch by 22-inch Corrugated Metal Pipe Arch	52 lin. ft.	5.00	4.46	5.00
24. Furnishing and Installing 43-inch by 27-inch Corrugated Metal Pipe Arch	84 lin. ft.	7.50	6.74	7.50
25. Furnishing and Installing 50-inch by 31-inch Corrugated Metal Pipe Arch	102 lin. ft.	11.50	8.46	9.00
26. Furnishing and Installing 58-inch by 36-inch Corrugated Metal Pipe Arch	64 lin. ft.	12.00	9.92	12.00
27. Furnishing and Installing 72-inch Circular Multi-Plate Corr. Met. Pipe	165 lin. ft.	30.00	27.00	20.00
28. Railroad Overpass, Excluding Piling, Rail, Guard Rail and Appurtenances	lump sum	28,500.00	28,225.00	26,087.00
29. Rail, Guard Rail Appur. for Overpass	lump sum	500.00	3,000.00	250.00
30. Piling, Excluding Cut-off	4,120 lin. ft.	2.75	2.75	3.00
31. Grade Crossings, Road	312 lin. ft.	8.00	8.00	7.40
32. Grade Crossings, Farm	144 lin. ft.	6.00	5.00	4.00
33. Crossing Approach Surfacing	26 cu. yd.	4.00	5.00	2.00
34. Right-of-Way Fence	3,810 rod	2.65	2.35	2.50
35. Removal Disp. of Exist. Fencing	45 rod	1.00	.55	.50
36. Gates, 16-foot Width	18 each	25.00	100.00	50.00
37. Snow Fence	3,890 lin. ft.	3.25	3.00	2.90
38. Stock Guards	15 each	200.00	100.00	150.00
39. Highway Crossing Signs	18 each	60.00	35.00	50.00
40. Derail Signs	4 each	30.00	35.00	15.00
41. Whistle Signs	16 each	30.00	35.00	15.00
42. Mile Post Signs	10 each	30.00	35.00	15.00
43. Track Car Set-Offs	9 each	40.00	150.00	18.00

Highway, Concrete, to Garrison Dam Site

OWNER: U. S. Engineers, Omaha District, Lt. Col. D. B. Freeman, District Engineer, Omaha, Nebr.

PROJECT: Concrete highway including grading and drainage, 13½ miles to Garrison Dam site.

CONDITIONS: All materials to be furnished by contractor. Rail transportation at one end, highway transportation at other end. Limited quantities of good quality aggregate in vicinity. Minimum wage rates specified: ironworkers, structural, $1.50; reinforcing, $1.44; carpenters, $1.25; operators: compressor, $1.00; cranes and shovels and draglines, $1.50; hoists, $1.40; motor graders, $1.40; pavers, $1.40; mixers, $1.00; pile drivemen, $1.25; rollers (to 8 tons), $1.20; (over 8 tons), $1.40; tractors, $1.30; trucks, 80c.; common labor, 70c.

BIDS: Six bids were received April 2, 1946, ranging from the low, $1,163,030.45; 3.8 percent below the Government estimate, $1,208,862.38, to a high bid of $1,801,308.17.

LIST OF BIDDERS:

1. S. J. Groves & Sons, Co., Minneapolis, Minn. (contract) $1,163,030.45
2. W. H. Noel Co., Jamestown, N. Dak. 1,208,518.76
3. Northwestern Engr. Co., Rapid City, S. Dak. 1,300,326.89
4. Western Contracting Corp., Sioux City, Iowa 1,346,096.14
5. Peter Kiewit Sons Co., Omaha, Nebr., and Morrison-Knudsen Co., Seattle, Wash. 1,424,346.13
6. Okes Construction Co., St. Paul, Minn. 1,801,308.17

Item	Quantity	Unit Prices (1)	(2)	(3)
1. Clearing and grubbing	41 acre	$150.00	$100.00	$150.00
2. Unclassified excavation	750,000 cu. yd.	.24	.19	.19
3. Excav. of impervious overburden	60,000 cu. yd.	.22	.12	.20
4. Excav. of pervious material	572,480 cu. yd.	.45	.50	.51
5. Structural excavation	1,700 cu. yd.	1.00	1.00	1.50
6. Water for compaction	35,000 1,000 gal.	2.00	1.22	1.25
7. Rolling for addnl. compaction	500 roller hr.	4.00	4.50	5.00
8. Compacted gravel surfacing	34,610 cu. yd.	1.50	1.54	1.90
9. 18-in. reinf. concr. pipe	862 lin. ft.	2.25	2.51	3.00
10. 24-in. reinf. concr. pipe	1,254 lin. ft.	3.00	3.71	4.00
11. 30-in. reinf. concr. pipe	434 lin. ft.	4.50	5.34	5.25
12. 18-in. reinf. concr. flared ends	62 each	18.00	22.15	30.00
13. 24-in. reinf. concr. flared ends	54 each	25.00	31.40	38.00
14. 30-in. reinf. concr. flared ends	14 each	35.00	44.00	50.00
15. 24-in. corrug. met. culv. pipe	340 lin. ft.	3.25	3.67	3.40
16. 30-in. corrug. met. culv. pipe	120 lin. ft.	4.50	4.51	4.25
17. 36-in. corrug. met. culv. pipe	388 lin. ft.	5.00	5.41	5.25
18. 42-in. corrug. met. culv. pipe	92 lin ft.	7.00	6.41	6.00
19. 48-in. corrug. met. culv. pipe	324 lin. ft.	9.50	10.23	11.00
20. 54-in. corrug. met. culv. pipe	196 lin. ft.	10.00	17.88	17.00
21. 72-in. multiplate corrug. met. culv. pipe (10 gauge)	580 lin. ft.	20.00	22.17	23.00
22. 72-in. multiplate corrug. met. culv. pipe (12 gauge)	190 lin. ft.	17.00	17.38	20.00
23. Grouted stone gutter	43 cu. yd.	15.00	18.00	22.50
24. Reinf. concr. for ditch checks & concr. culv. headwall	20 cu. yd.	45.00	50.00	50.00
25. Guard posts	195 each	3.00	5.00	5.00
26. Snow fence	11,200 lin. ft.	.35	.25	.30
27. Steel snow fence posts	1,150 each	1.00	1.00	1.00
28. Removal of exist. fencing	1,900 rod	.50	.75	.50
29. Erection of new fence	1,284 rod	3.50	2.50	1.95
30. Erection of wooden gates	11 each	30.00	40.00	30.00
31. Install. permanent road signs	28 each	15.00	25.00	30.00
32. Referencing of alignment control points	55 each	10.00	8.00	15.00
33. R. R. traffic signals installed	1 set	2,500.00	3,500.00	1,500.00
34. Reinforced concrete pavement	168,127 sq. yd.	1.85	2.42	2.77
35. Cement	57,000 bbl.	3.10	3.09	3.30
36. Compacted gravel shoulders	127,710 sq. yd.	.30	.20	.15
37. Road maintenance	50 day	65.00	66.00	60.00

UNIT PRICES BID BY CONTRACTORS

Simms Bayou Sewage Treatment Plant, Houston, Texas

OWNER: Public Works Department, Houston, Texas. J. G. Turney, director-engineer; W. E. White, chief design engineer.

PROJECT: Simms Bayou Sewage Treatment Plant, (Activated Sludge Process) Construction Contract, No. 1, covering excavation, under drainage system, pipe, sluice gates and valves, connecting sewers primary and final settling tanks.

CONDITIONS: Owner furnishes equipment only. Contractor to complete job in 240 working days. Transportation facilities include concrete highway, water route and railway. Adjoining the site are rail and spur tracks. Uniformity of concrete sections in various structures designed to hold down cost. Specified wage rates include: skilled labor, $1.375 for commercial carpenters to $1.725 per hour for bricklayers; bricklayer's apprentice, from 57c. for 1st six months, to $1.29 for 8th six-months; apprentice cement finisher, 75c. for 1st year, to $1.25 for 4th year; common labor, 60c.

BIDS: Eight bids were received on March 13, 1946, ranging from the low of $705,412.90 to $1,031,830.

LIST OF BIDDERS:

1. Russ Mitchell, Inc., & Bishop Brick Co., Houston, Tex. (contract) $705,412.90
2. J. W. Bateson, Dallas, Texas 720,264.00
3. R. F. Ball Constr. Co., Inc., Houston, Texas 795,290.04
4. R. P. Farnsworth & Co., Inc., Houston, Texas 839,030.82
5. Brown & Root, Inc., Houston, Texas 865,440.00
6. Thomas Bate & Sons, Houston, Texas 891,721.95
7. Tellepsen Constr. Co., Houston, Texas 975,156.85
8. Holland Constr. Co., Houston, Texas 1,031,830.00

Item	Approx. Quan.	Unit Prices (1)	(2)	(3)
General Units				
1. Clearing	6 acre	$200.00	$300.00	$331.40
2. Excavation with earth disposal in embankment on site				
1. Common excavation from above el. 18.5	24,100 cu. yd.	0.85	0.50	0.44
3. 2. Unclassified structural excavation below el. 18.5	69,500 cu. yd.	1.00	0.90	1.00
4. Roller (tamping) 2 drum	160 hr.	6.00	10.00	11.48
5. Roller (tamping) 4 drum	160 hr.	6.00	15.00	12.70
6. Excavation with earth disposal off-site by contractor				
Unclassified structural excavation, below el. 18.5	6,000 cu. yd.	1.05	0.80	0.29
7. Earth haul, disposal off-site as directed	12,000 yd. quar.	0.10	0.08	0.03
8. 8" open joint concrete sewer pipe under drains	2,920 ft.	0.62	1.00	0.56
Under Drainage System				
9. Compacted sand as of specf. in place	3,600 cu. yd.	4.00	5.00	4.17
10. 1" grout over under drains, in place as of specs	400 cu. yd.	30.00	14.00	23.84
11. Copper water-stops as of spec. in place, complete	600 lb.	1.25	0.60	1.20
12. Concrete in structures in place, complete, steel extra				
Concrete, Class "A"	10,939 cu. yd.	30.00	33.00	32.29
14. Concrete, Class "C"	100 cu. yd.	20.00	12.00	27.29
15. Concrete grout, settling tank floor as of plans and spec.	160 cu. yd.	25.00	15.00	47.38
16. Steel, concrete reinforcement, in place	1,540,000 lbs.	0.068	0.07	0.103
17. Concrete admixture as of spec	80,000 lbs.	0.11	0.10	0.14
18. Timber left in foundns or in trenches	15 Mfbm	160.00	100.00	159.25
Cast Iron Pipe in Place, Complete				
19. 6" pipe line	225 lin. ft	3.50	2.00	3.21
20. 8" pipe line	440 lin. ft.	4.50	2.50	4.31
21. 10" pipe line	660 lin. ft.	6.00	3.50	5.55
22. 12" pipe line	920 lin ft.	9.00	4.30	6.32
23. 14" pipe line	10 lin ft.	11.00	10.00	7.45
24. 20" pipe line	105 lin. ft.	14.00	8.00	15.50
25. 36" pipe line	60 lin. ft.	30.00	30.00	45.90
26. Trench excav. for Cast Iron pipe lines	1,500 cu. yd.	1.00	1.50	3.77
Cast Iron Pipe Fittings				
27. In place, complete, as of specifications (a) Bell and spigot	43,800 lbs.	0.12	0.12	0.15
28. (b) Flange or flange & bell	13,200 lbs.	0.16	0.20	0.21
Galvanized Steel Pipe				
29. Hand rail, complete in place as of specifications	162 ft.	4.00	5.00	4.03
30. Steel subway grating, in place	1,500 lbs.	0.50	0.50	0.48
Sluice Gates and Drain Valves, in Place Complete (See Plans for Reference Numbers)				
31. Sluice gate—36"x36" gate ref. No. 1	1 each	918.00	900.00	598.23
32. Sluice gate—48"x48" gate ref. No. 2	3 each	1,050.00	1,000.00	788.60
33. Sluice gate—42"x36" gate ref. No. 3	6 each	950.00	900.00	696.36
34. Sluice gate—48"x48" gate ref. No. 4	11 each	1,530.00	1,400.00	785.48
35. Sluice gate—36" circular gate ref. No. 8	6 each	1,100.00	1,200.00	540.94
36. Sluice gate—36"x36" gate ref. No. 11	4 each	775.00	750.00	503.69
37. Sluice gate—20"x20" gate ref. No. 12	2 each	463.00	400.00	349.19
38. Slide gate 3'-3"x2'-9" gate ref. No. 14	18 each	60.00	60.00	61.65
39. Plug drain valve 12" dia. gate ref. No. 5 and 10	14 each	200.00	200.00	339.72
40. Flap valve 10" dia. gate ref. No. 6	6 each	50.00	60.00	138.45
41. Flap valve 12" dia. gate ref. No. 7, 9 and 13	4 each	60.00	70.00	157.45
42. Telescoping valve 12" dia. gate ref. No. 15	4 each	300.00	350.00	251.65
43. 4" pressure relief valve in place complete—ref. No. 16	60 each	9.00	10.00	21.39
44. 4" pressure relief valve in place complete—ref. No. 17	30 each	9.00	10.00	21.39
Gate Valves Installed in Cast Iron Lines, Complete				
45. Gate valve 12" dia. valve ref. CV. 1	2 each	200.00	200.00	408.83
46. Gate valve 12" dia. valve ref. GV. 2	1 each	220.00	225.00	396.35
47. Gate valve 12" dia. valve ref. CV. 3	4 each	230.00	228.00	377.34
48. Gate valve 12" dia. valve ref. GV. 4	2 each	230.00	230.00	377.91
49. Gate valve 6" dia. valve ref. GV. 5	2 each	150.00	100.00	251.93
50. Extra Riser Stem	5 lin. ft.	3.00	10.00	4.54
Sewer Construction Quantities, in Place Complete				
51. Timber ordered left in trench	10 mfbm	160.00	200.00	179.93
52. Extra Brickmasonry	2 cu. yd.	10.00	50.00	27.57
53. Extra castings	20,000 lbs.	0.12	0.15	0.176
54. Standard manhole type A	1 each	125.00	200.00	109.12
55. Extra depth M. M. type A	2 ft.	20.00	30.00	14.07
56. 18" concrete sewer pipe load 0–6' deep	18 ft.	6.00	6.00	38.42
Monolithic Reinforced Concrete Sewers				
57. 36" 0– 6' deep	140 ft.	12.00	11.00	21.49
58. 36" 6– 8' deep	280 ft.	14.50	12.00	24.02
59. 36" 8–10' deep	100 ft.	16.50	25.00	27.16
60. 42" 0– 6' deep	10 ft.	14.50	15.00	35.99
61. 42" 6– 8' deep	100 ft.	16.50	20.00	39.18
62. 48" 0– 6' deep	40 ft.	16.50	22.00	25.41
63. 48" 6– 8' deep	70 ft.	18.00	25.00	27.92
64. 48" 8–10' deep	60 ft.	25.00	30.00	30.44
65. 48" 10–12' deep	80 ft.	30.00	34.00	31.71
66. 48" 12–14' deep	50 ft.	40.00	37.00	34.33
67. 48" 14–16' deep	20 ft.	43.00	40.00	38.70
68. 60" 0– 6' deep	230 ft.	25.00	24.00	27.60
69. 60" 6– 8' deep	110 ft.	27.50	25.00	30.11
70. 60" 8–10' deep	50 ft.	30.00	30.00	31.36
71. 60" 10–12' deep	30 ft.	32.50	35.00	33.89
72. 60" 12–14' deep	80 ft.	42.50	38.00	36.41
73. 60" 14–16' deep	10 ft.	45.50	40.00	38.92
74. 18" corrugated iron pipe double dipped asphalt coated, in place	74 ft.	3.00	10.00	6.65
Primary Settling Tanks				
75. Scum-Baffle, with anchor bolts complete in place as of plans	2 each	750.00	750.00	1,211.50
76. Steel notched weir with anchor bolts complete in place as of plans	2 each	600.00	600.00	1,238.33
77. Erection of Dorr mechanical equipment in place as of plans and specifications complete	2 each	800.00	1,500.00	2,056.62
Final Settling Tanks				
78. Steel notched weir with anchor bolts complete as of plans in place	4 each	750.00	600.00	1,377.50
79. 36"–10 Ga.-asphalt coated plain, pure iron gal vanised or equal Influent pipe in place as of plans and specifications	100 ft.	15.00	11.00	11.26
80. Erection of Dorr mechanical equipment units in place as of plans and specifications complete	2 each	700.00	1,400.00	1,627.71
81. Steel plate complete final effluent weir	1 each	100.00	80.00	137.89
Extra Work Items				
82. Hauling, ton mile	200 ton mile	1.00	2.00	0.83
83. Extra work, common labor	1,000 man hr.	1.25	1.10	1.13
84. Skilled labor	400 man hr.	2.25	2.50	2.39
85. Engineer's office complete as of specifications	Lump Sum	1,000.00	2,000.00	1,077.46
86. Rolling-sand Under-drainage (compaction)	80 roller hr.	10.00	10.00	11.40
87. Sprinkling-sand under-drainage	1,000 M. gal.	1.25	3.00	0.89

New Aids to the Constructor

MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

Grass Seeder

On park, highway and airport work the new Byers grass seeder will sow a strip 8 ft. wide and cover 8 to 10 acres in an 8-hr. day, it is stated. This machine seeds, rakes and rolls in one operation. A force feed mechanism in the bottom of the hopper assures even distribution of the seed until the hopper is empty.—*P. L. Byers, Clyde, Ohio.*

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Tandem Roller

A new portable, 3 to 4-ton tandem roller for compacting driveways, parking areas, tennis courts, and sidewalks, has been announced. Mobility is obtained through a low pressure hydraulic steering control which responds instantly. The need for hand tamping around corners is greatly decreased, as the roller is able to move freely along walls and curbs.—*The Buffalo-Springfield Roller Co., Springfield, Ohio.*

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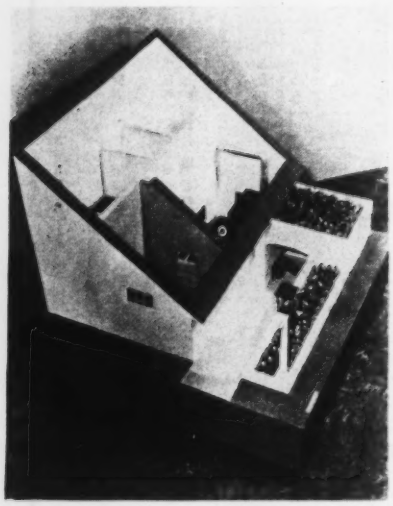
Utility Heating Room

Aimed primarily at eliminating expense of full-basement construction while retaining desirable features of a basement heating plant and adequate coal storage space, a new utility room, called the "Simpli-Fire" room has been designed



for *The Anthracite Institute, 101 Park Ave., New York, N. Y.*, by *Randolph Evans*, of the firm of *Chapman & Evans*, architects. The room is arranged to do away entirely with ash shoveling; ashes drop below floor level into a removable container under furnace or boiler.

The "Simpli-Fire"—part of the kitchen-heating-laundry work wing—is sunk about 3½ ft. below frost line, to save excavation costs and extensive waterproofing. Heated air circulates through two grilles to assure warm floors. Warm air, steam or hot water systems may be used.

• • •

Cam-Lever Grip

Quickly installed, a new cam-lever and chain, Granny-Grip, grabs and holds barrels, plates, etc. firmly; the heavier the load, the tighter it is held. This device lets go as soon as the load is put down, and is said to be capable of lifting

any load that its ¾-in. jaws can be slipped over.

The standard grip unit consists of two stamped alloy steel bodies, with cam lever mechanism, and a Herc alloy chain. —*The Boyer-Campbell Co., Safety Division, 6540 St. Antoine St., Detroit 2, Mich.*

• • •

CO_2 Fire Extinguisher

Fires in shipyards and factories may be quickly subdued, it is claimed, with a 15 lb. CO_2 extinguisher, which may be carried in one hand. Penetrating carbon dioxide gas is released at one touch of the thumb trigger; release of the trigger automatically stops the flow. The long-range hose and nozzle keep the firefighter at a safe distance from the blaze. —*Randolph Laboratories, Inc.*, 8 *East Kinzie St., Chicago* 11, *Ill.*

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Water Filtration Unit

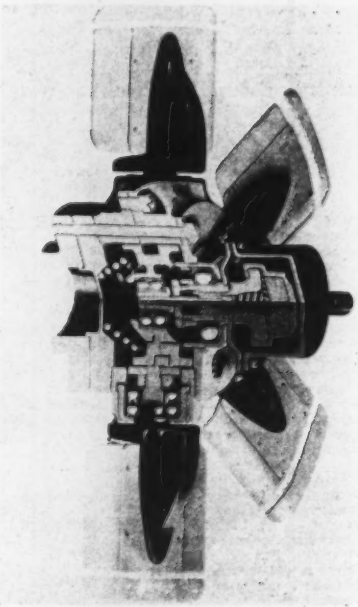
For use on construction jobs or wherever a lightweight filtering unit is required, the Hand Pur-O-Pumper has been announced. This portable, hand-operated pump, diatomaceous earth feeder and filtering unit consists of a priming synthetic rubber vaned impeller section. The rust and corrosion resistant unit can deliver 2 gal. of filtered water per minute and weighs about 55 lb.

The pumping unit consists of a self-priming synthetic rubber vaned impeller, and bronze rotary displacement pump, mounted on a tripod stand. The 5-in. dia. stainless steel filter unit is equipped with pressure gage, precoat feeder and connections. The tank contains a cylindrical aluminum oxide filter stone where the diatomaceous earth is deposited. Water from the filter unit is collected in a Lyster bag or other container, and purified by an ampule of calcium hypochlorite.—*Proportioneers, Inc.*, 92 *Codding St., Providence, R. I.*

• • •

Thermo-Control Fan

Designed for installation on such heavy-duty equipment as trucks, cranes, shovels, pumping units, etc., the Thermo-Control fan is a variable pitch, self-adjusting fan operated by a built-in thermal power element. It adjusts itself to changes in en-



gine and ambient temperature and maintains nearly constant engine operating temperature, which is said to increase horsepower output, reduce fuel, lubricating and maintenance costs, and to lessen formation of sludge deposits.

The fan is manufactured in 4, 6 and 8 blade models.—*Evans Products Co., 15310 Fullerton Ave., Detroit 27, Mich.*

THERE'S A *Timken Rock Bit*

FOR PRACTICALLY EVERY KIND OF ROCK

The M series: an intermediate bit to the H and D series, designed largely for mining with heavy-duty equipment.

The K series: a bit used in soft formations such as limestone and sandstone.

The D series: a bit used with heavy drilling machines and large section drill steels.

The H series: a general purpose bit for light and medium weight drills adaptable to any popular hollow drill steel section.

The F series: a sturdy bit designed to achieve fast drilling by virtue of its small gauge.

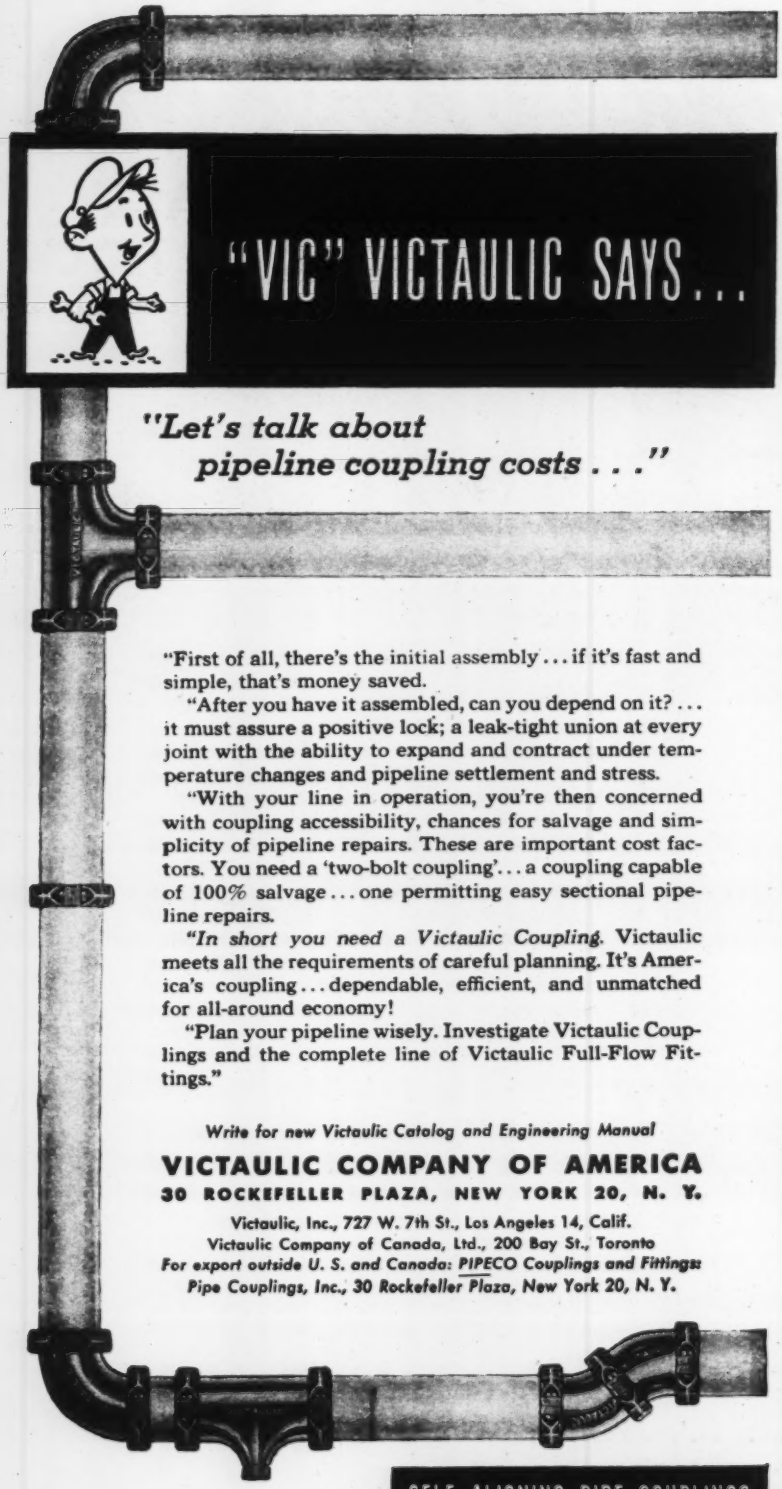
Introduced fourteen years ago, the Timken Rock Bit of today bears a remarkably close resemblance to those on the market in 1932. Improvements have been made—streamlined then, it's more streamlined now; heavy wing sections have become heavier—but basically it's the same design. Fourteen years' experience has confirmed its correctness.

THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

ROCK BITS


"VIC" VICTAULIC SAYS...
"Let's talk about pipeline coupling costs . . ."
"First of all, there's the initial assembly . . . if it's fast and simple, that's money saved.
"After you have it assembled, can you depend on it? . . . it must assure a positive lock; a leak-tight union at every joint with the ability to expand and contract under temperature changes and pipeline settlement and stress.
"With your line in operation, you're then concerned with coupling accessibility, chances for salvage and simplicity of pipeline repairs. These are important cost factors. You need a 'two-bolt coupling'... a coupling capable of 100% salvage ... one permitting easy sectional pipeline repairs.
"In short you need a Victaulic Coupling. Victaulic meets all the requirements of careful planning. It's America's coupling ... dependable, efficient, and unmatched for all-around economy!
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Manufacturers' Activities

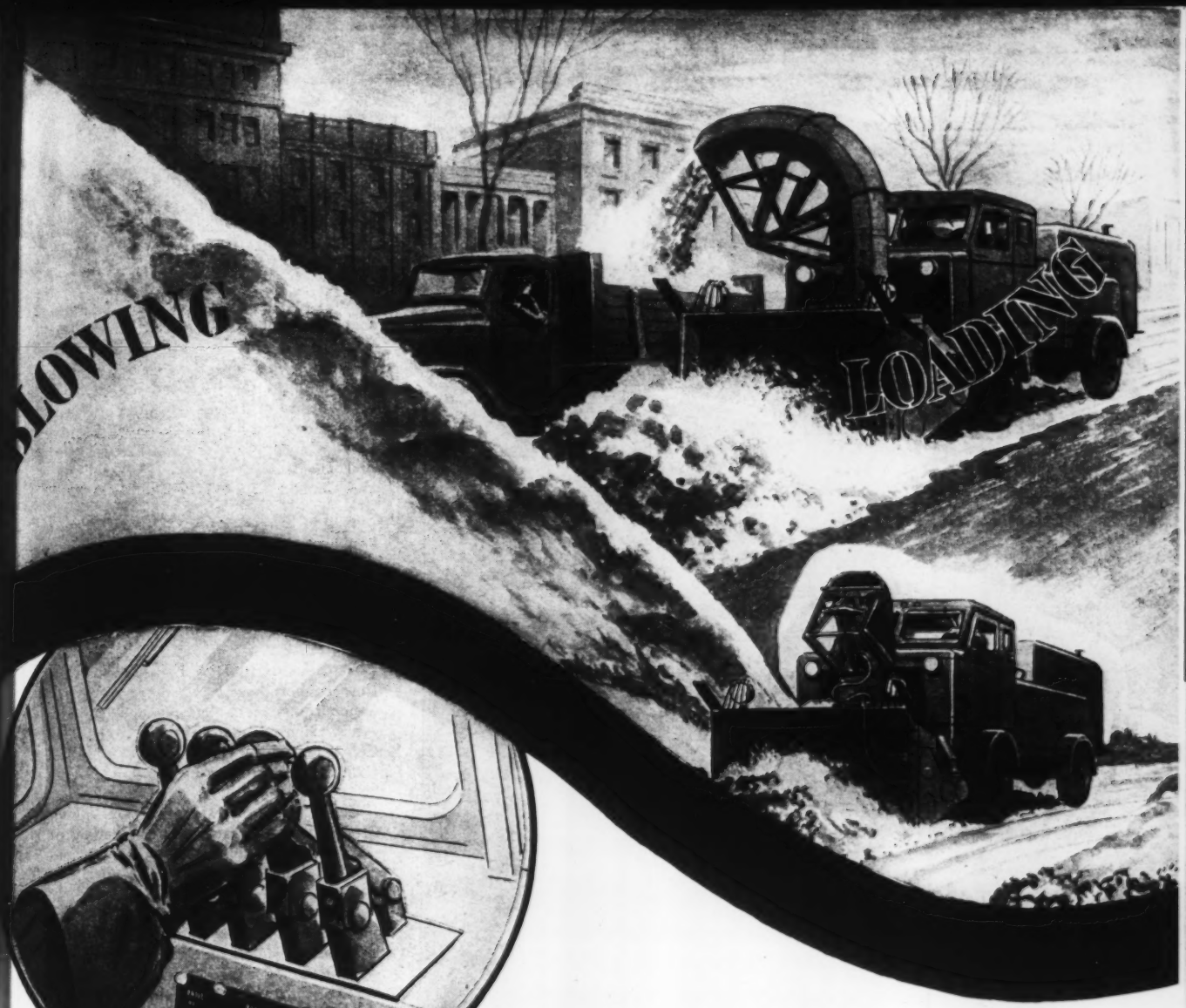
PROTECTED STEEL PRODUCTS of Washington, D. C., and Pittsburgh, Pa., has named Earl L. Wiseman of Cleveland general sales manager, and is planning an extensive sales program under his direction. Included is a newly formed fabricating division for the manufacture of industrial ventilators and building sheet metal products. In addition, the company plans the wider distribution of its other products, roofing and siding.

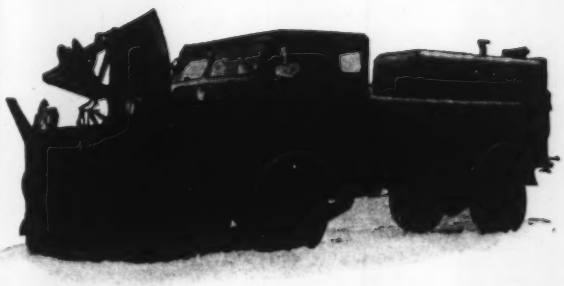
Mr. Wiseman is an authority on industrial ventilation. During the war, he was responsible in a measure for certain radical changes made in the design of steel mills and other heavy types of industrial buildings. One of the most outstanding was the new open hearth building of the Henry Kaiser Iron & Steel division on the Pacific Coast. Mr. Wiseman was formerly vice-president-manager of the ventilating division of the Swartwout Co. of Cleveland, Ohio.

PURCHASE of The A. H. Ross Co., manufacturers of packaging machinery, by Rockwell Manufacturing Co., Pittsburgh, Pa., has been announced by Willard F. Rockwell, chairman and president. Clair S. Hall of Cincinnati negotiated the transaction. A. H. Ross, president and principal stockholder of the Ross Co., will become vice-president and general manager of the packaging machinery division of Rockwell, but the company will continue to operate under the name of A. H. Ross Co., and maintain its plant in Ludlow, Ky.

APPOINTMENT of the Jameson Engineering Co., Fairbanks, Alaska, as sales agent for Lima shovels, cranes and draglines in Alaska is announced by Paul R. Ehrgott, general sales manager, shovel and crane division, Lima Locomotive Works, Inc., Lima, Ohio.

WALLACE & TIERNAN CO., INC., and The Dorr Co. have purchased the interest of E. H. Ingle and have become joint owners of the Electro Rust-Proofing Corp. of Dayton, Ohio. E. H. Ingle continues as president and general manager. The corporation furnishes equipment and engineering services for the cathodic protection of tanks and submerged metal





THE operator, inside the cab of the Sicard Snow Blower, makes all adjustments. Under his sensitive control the Sicard Snow Blower does a thorough job of removing dry, wet or impacted snow . . .

. . . Loads a 12-yard truck in 30 seconds . . . blows snow 150 feet or more . . . slices off ice-walled ruts.

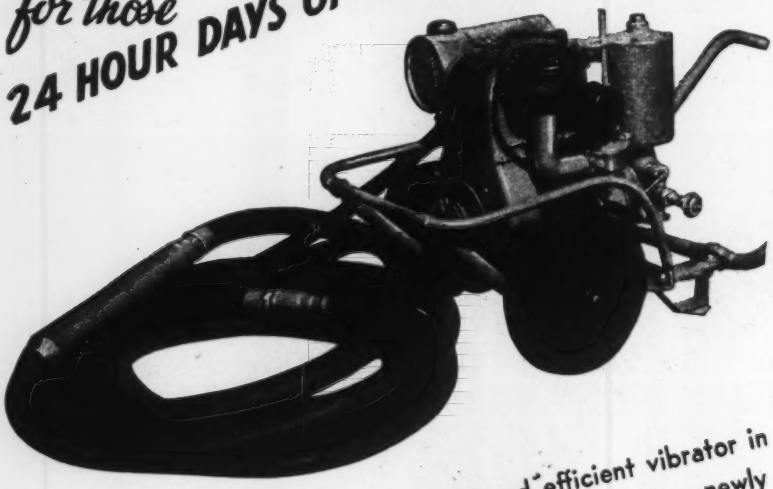
There is plenty of weight and power to enable the Sicard Snow Blower to punch its way through deep, frozen drifts. It gets traffic moving faster on airfields, railways, highways or streets.

Records show that a Sicard Snow Blower can pay for itself in one season. Models are available for road or rail operations.

SNOW BLOWERS

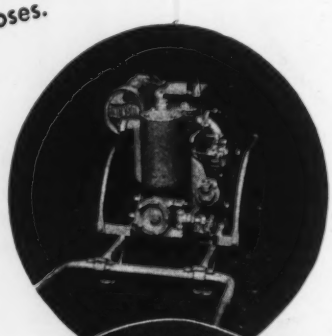
The JACKSON Hydraulic CONCRETE VIBRATOR

for those 24 HOUR DAYS OF CONTINUOUS SERVICE



Thoroughly proved the most dependable and efficient vibrator in its class on practically every major wartime project. Now newly streamlined for even greater convenience and efficiency, the JACKSON Model HS-A1 is by long odds the best buy for general, all-around concrete construction purposes.

Vibrator head driven by hydraulic motor. Standard head 2¾" x 21". Vibratory frequency instantly adjustable from 3000 to 7000 V.P.M. All moving parts submerged in oil. Rugged, neoprene lined hose 34 feet long. Husky Wisconsin engine. Wheelbarrow mounting balanced for light lift, with drop handles for easy hose manipulation. Grinding and drilling attachments available. See it at your JACKSON distributor or write for further details. Other JACKSON models to ideally suit every concrete vibratory requirement.



ELECTRIC TAMPER & EQUIPMENT CO.
LUDINGTON MICHIGAN

structures in the waterworks and sewage fields.

GEORGE R. WERNISCH has been appointed assistant manager of the concrete engineering division of Ceco Steel Products Corp. He will be at the firm's manufacturing division plant in Chicago.

ADVANCEMENT of Kenneth F. Park, sales development manager of Caterpillar Tractor Co., to the newly-created post of engineering consultant on all matters pertaining to the earth-moving field, is announced by H. H. Howard, general sales manager of the Company. Mr. Park will serve Caterpillar's three sales divisions which cover the United States and Canada.

THE LE ROI CO., Milwaukee, Wis., has announced the appointment of John M. Dolan as vice president in charge of sales. The same company named Cecil W. Brown as general sales manager, succeeding Mr. Dolan in that position.

BRIG. GEN. HERMON F. SAFFORD, wartime rubber director of the U. S. Ordnance Department, has been elected executive vice president of the Ohio Rubber Co., Willoughby, Ohio, and Long Beach, Calif.

C. T. RUHF, president of the Mack Mfg. Corp., has announced election of W. M. Walworth as vice president and chief engineer.

C. Q. WRIGHT has returned to the employ of the Whiting Corp., Harvey, Ill., as vice president dealing with special staff work. Mr. Wright served as a submarine commander in World War II with the rank of captain.

THE FORT PITT BRIDGE Works, Pittsburgh, Pa., has announced the appointment of A. D. Graves as district manager of their Cleveland territory. His headquarters will be at the Bulkley Building, Cleveland, Ohio.

E. T. TULLER has been appointed domestic sales manager for Athey Products Corp. Mr. Tuller joined the company in 1940 as a special representative in the introduction of the force-feed loader to the distributors' sales organization.

THE FORMATION of Philippine Industrial Equipment Co., a million peso Philippine corporation already active in the exportation and servicing of machinery and supplies required to rebuild the islands' war ravaged mines, mills and factories, has been announced. Ownership rests with the Bechtel interests and associates, A. Soriano y Cia., of Manila. Morrison-Knudson Co., and K. D. Dawson. Headquarters have been established in Manila.

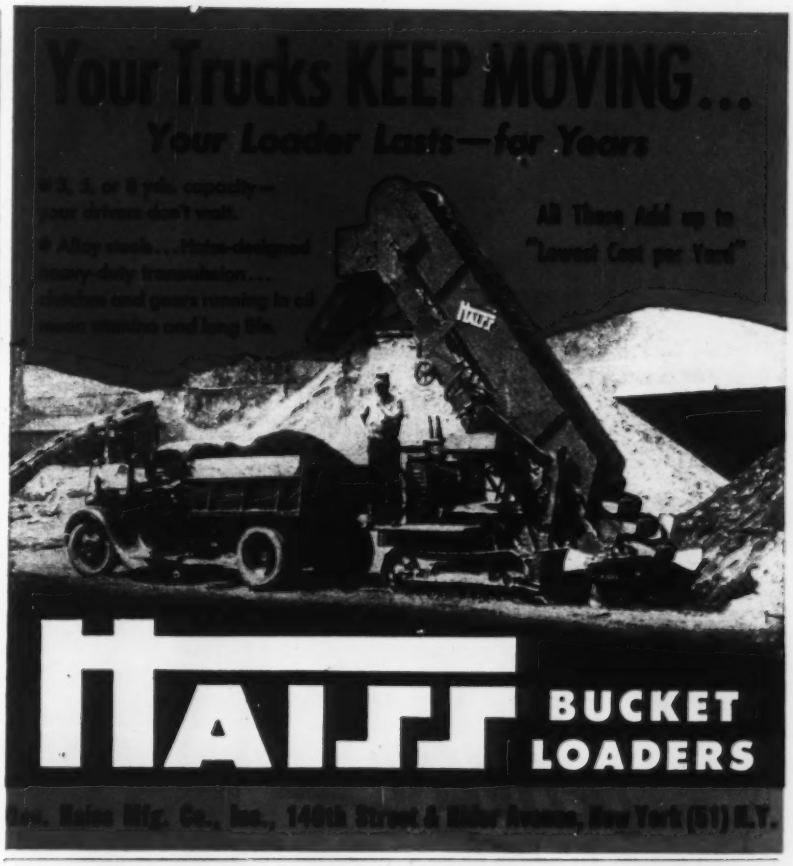
Manufacturers' Publications

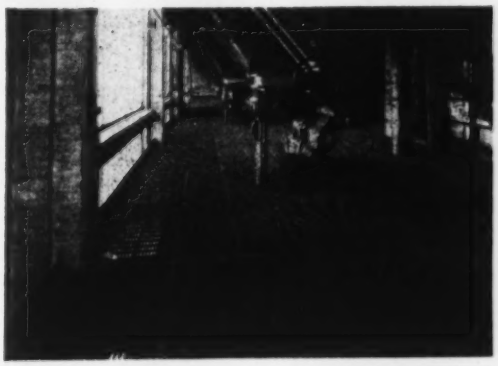
Installing Cast Iron Pipe—A sound motion picture has been produced on the subject of installing cast iron pipe. Available on loan to engineering bodies and schools and to municipal departments it is a free contribution to good practice in the handling and installation of pipe for underground mains.—*Cast Iron Pipe Research Assn., Peoples Gar Building, Chicago, Ill.*

Dryseal Pipe Threads—An 8-page booklet containing information on the recently set up standard for improvement in pipe threads, known as dryseal is available. The booklet explains what dryseal pipe threads are, how they work, and recommended practices. It also carries charts and drawings which will be found interesting to engineers, designers, and purchasing agents.—*The Weatherhead Co., 300 East 131st Street, Cleveland 8, Ohio.*

Prefab Houses—A 24-page illustrated booklet describes prefabricated houses being made under the veterans' emergency housing program. It explains the construction, erection, financing and distribution of these permanent factory-built homes and answers questions asked about them.—*Prefabricated Home Manufacturers' Institute 1232 Shoreham Building, Washington 5, D. C.*

Sewage Works—A 2-part, 78-page brochure is entitled "Products for the Sewage Works Industry." Part one contains over 100 photographs of actual installations of the many asbestos products in sewage system and treatment plants. Typical applications are: Insulation for digestors, boilers, steam and hot water lines, sludge incinerators and furnaces; packings for sewage and sludge pumps; gasketing for chlorinator piping; ventilators on digestor control vaults; sewer pipe for gravity lines; pressure pipe for force mains; "S" pipe for venting gases, vapors, etc.; control panels and instrument boards in treatment plants; gates in settling tanks and table tops in laboratories; sheets for building construction; acoustical materials for noise control in laboratories, offices and pump rooms; roofing and shingles for administration buildings, digestors, filter houses, etc.; waterproofing materials for sludge tanks; and refractories for sludge incinerators and air preheaters.—*Johns-Manville, Box 290, New York 16, N. Y.*





FOR SAFETY
STRENGTH
DURABILITY

USE MITCO
OPEN STEEL
FLOORING

The square-edge, uniformly spaced metal bars provide a non-slipping surface; the rectangular spacings and 90% open area permit maximum lighting and ventilation.

■ Of pressure formed construction, there are no welds to weaken, no rivets to loosen, no bolts to rust—no dirt-catching nor light-obstructing projections.

■ Every Mitco panel is a strong, integral unit, capable of supporting heavy loads without lateral deflection.

■ *Send details of area to be covered, giving size, type and location of supports, and Hendrick will submit Mitco recommendations—without obligation. Write for complete information.*

HENDRICK
Manufacturing Company
45 DUNDAFF STREET, CARBONDALE, PENNA.
Sales Offices In Principal Cities

Perforated Metals
Perforated Metal Screens
Architectural Grilles
Mitco Open Steel Flooring,
"Shur-Site" Treads and
Amorgrids.

SAME-DAY delivery between many airport towns and cities as far as 1,000 miles apart. (Less than 6 hours by air.) Coast-to-coast overnight.

SPECIAL HANDLING—special pick-up and delivery (no extra cost) promotes speed of Air Express delivery.

GOES EVERYWHERE. In addition to 375 airport communities, Air Express goes by rapid air-rail schedules to and from 23,000 other points in this country. Service direct by air to and from scores of foreign countries in the world's best planes giving the world's best service.

RATES CUT 22% SINCE 1943 (U.S.A.)					
AIR MILES	2 lbs.	5 lbs.	25 lbs.	40 lbs.	Over 40 lbs. Cents per lb.
149	$1.00	$1.00	$1.00	$1.23	3.07¢
349	1.02	1.18	2.30	3.68	9.21¢
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Elections and Activities

Ohio Society of Professional Engineers has elected A. C. Neff, Cleveland, president; J. D. Coleman, Dayton, and Alfred Le Feber, Cincinnati, vice-president; J. R. Shank, Columbus, treasurer; and D. W. Converse, Akron, secretary.

E. A. Ryan, consulting engineer, Montreal, Que., has been elected president of The Corporation of Professional Engineers of Quebec, Louis Beaudry, councillor and Marc Boyer, registrar.

New officers elected by the New Jersey Sewage Works Association are: Louis J. Fontenelli, of Rahway, president; Leslie E. West, of Elizabeth, first vice-president; John Struss of Newark, second vice-president, and Michael S. Kachorsky of Manville, secretary-treasurer. Members of the executive committee are: Kachorsky, John H. Simmerman of Pitman; Frank Van Orden of Bernardsville; A. J. Macri of Hammonton, and P. N. Daniels and S. A. Kowalchik of Trenton.

Organization of the Kansas Engineering Council was perfected at a meeting of officers and representatives of four associations in Topeka recently. Represented were the Kansas Association of City Engineers, the American Society of Civil Engineers, the Kansas Engineering Society, and the Kansas Society of Professional Engineers.

C. Y. Thomas, of Pittsburgh, elected chairman of the council, said the purpose was to upgrade the quality of engineering in Kansas. This will be done through seeing that the state has adequate engineering laws.

Murray A. Wilson, of Salina, was elected vice-chairman. E. E. Larson, Douglas County engineer, Lawrence, was elected secretary.

The South Carolina Water and Sewage Works Association has elected these officers: Marshall Bright, superintendent, Lyman, S. C., water plant, president; William R. Wise, engineer, Newberry, S. C., waterworks, vice-president; and D. F. Finks, senior sanitary engineer State Board Health, secretary-treasurer.

The Builders Association of Kansas City, Mo., recently elected the following directors: Benjamin F. Cockerell, Edwin Elliott, Harman R. Brown, George H. Fieske, Frank H. Spink, Forrest F. Dodds, W. T. Conroy, J. C. Pedersen, Tom J. Daly, and Paul A. Jordan.

Men and Jobs

Edgar T. Ham, city engineer of San Bernardino, Calif., recently received congratulations from city officials on completion of 40 years of service as a public and private engineer. Born in Waco, Tex., in 1886, Mr. Ham moved to San Bernardino 54 years ago, beginning his engineering career there when he started as a chairman on a crew making surveys at Little Bear Dam, forerunner of Lake Arrowhead. He has since served as deputy county surveyor, county surveyor, superintendent of construction for the Arrowhead Lake Corp., and since 1941 as city engineer of San Bernardino.

The appointment of **Joseph F. Cairnes,** associate commissioner of Public Works, Massachusetts, to be commissioner, has been confirmed by the Governor's Council. Mr. Cairnes succeeds Herman A. MacDonald, removed from office by Governor Tobin (ENR March 28, vol. p. 447). Motor Vehicle Registrar Rudolf F. King declined the post which was first offered to him.

C. F. Barstow, Stillwater, Minn., for 32 years an engineer for the Minnesota state highway department, is retiring. He was formerly city and county engineer at Stillwater. He will open an office at Stillwater for private practice.

Milton H. Irvine, former Navy engineer at Camp Pendleton, Oceanside, Calif., has been named city engineer at Riverside, Calif., where he began his duties May 1. He succeeds **Lee Nafzger,** who with four members of his staff, recently resigned in protest on salaries he termed inadequate. Irvine was in charge of road construction, sanitary developments, and other civil engineering projects at Camp Pendleton during the war. He received his engineering training at the University of Southern California.

J. C. Rollins, director of public works for Dallas, Tex., since 1941, has become city manager for Tyler, Tex. Prior to 1941, Mr. Rollins was division engineer, Texas State Highway Department, for a number of years. **J. C. Bisset,** present assistant city manager, replaces Mr. Rollins as director of public works. **Chas. C. Ford,** assistant city plan engineer, becomes assistant city manager.

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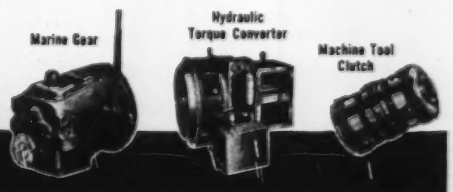

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To civilian activity

R. A. Martinsen, formerly a captain and company commander with the 344th Engineers, is now with Pfeifer & Schultz, Engineers, of Minneapolis, Minn.

Charles E. Cutts, formerly a captain with the Headquarters, African Middle East Theater, is now an instructor in the mathematics and mechanics department, University of Minnesota, Minneapolis.

Gerald W. Long, major, Corps of Engineers, has been appointed construction and maintenance engineer for Forsyth County, N.C., at Winston-Salem. He had been in charge of airport construction at Winston-Salem, and at one time was engaged in road construction in Texas.

Theodore B. Jensen, lieutenant colonel, who was in the headquarters, South Pacific Theater, and commanded a water supply battalion, is now chief of the technical section, Veterans Administration, Branch 8, in St. Paul, Minn.

W. C. Bowen, lieutenant colonel, after 4 years duty at the Armory School, Fort Knox, Ky., has become engineer of the water works at Spartanburg, S.C.

Harry D. Williar, Jr., lieutenant colonel, who was staff engineer with the Army Air Forces at the Richmond, Va., air base, Bolling Field and Langley Field in the late war and served with the A.E.F. in France and Germany in the first war, will direct the survey of the route for an expressway across Baltimore, Md.

After Army service of nearly five years, during which he rose from private to major, **Gerald A. Dodge** has returned to duty at Missoula, Mont. with the engineering department of the Public Roads Administration.

George W. Whittaker, released from active duty with the Army, has resumed his membership in Door, Hammond, Hand & Dawson, 61 Broadway, New York City.

George F. Hopkins, captain, chief of the operation division, Seattle District Army Engineers, has returned to the same duties as a civilian.

The Pennsylvania Department of Health has appointed two ex-servicemen as engineers in its bureau of engineering, **Christian L. Seibert, Jr.,** of Camp Hill, Pa., captain, Army Corps of Engineers and **Karl L. Dahl,** of Harrisburg, who served with the Seabees in construction work in the South Pacific and Japan.

B. F. Hatch, colonel, Corps of Engineers, is again partner of Burgess & Niple, civil and sanitary engineers, Columbus, Ohio.